E-government and corporate tax planning: International evidence

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Abstract

This study examines the impact of e-government advancements on corporate tax planning activities. We define e-government as the readiness and capacity of national institutions to use information and communications technologies to deliver public services. Using over 82,000 worldwide firm-level data from 10,936 unique firms in 56 countries over the period 2008-2021, we observe a negative association between a country's e-government advancement and the overall tax avoidance practices of firms. Via path analysis we identify the underlying mechanisms through which e-government affects corporate tax avoidance and document that the total tax enforcement budget but also specific technological features such as AI-machine learning, and robotic process automation explains a sizeable fraction of the negative relationship between e-government advancements and corporate tax avoidance. Additionally, our cross-sectional analysis reveals that the impact of e-government on curbing tax planning is particularly pronounced in environments where firms traditionally accrue tax benefits via investments into organizational capital. Our main findings remain robust after implementing an instrumental variables strategy and conducting various robustness tests. Collectively, our findings indicate that e-government investments can help raise a nation's tax revenue collection, as such investments are linked to reduced corporate tax avoidance activities.

Keywords: tax avoidance, tax planning, digitalization, e-government, digital governments.
JEL classification : G30 · G38 · H26 · L1 · M41 · M48

1 Introduction

Over the past years, governments worldwide have dramatically increased their budgets for digital transformation projects, and the pace of this effort was not least influenced by the COVID-19 pandemic outbreak in 2020 (UN DESA, 2020). In absolute numbers, global public investments on digital infrastructures and information technology have increased to over $550 billion in 2022 (Gartner, 2023), a number equivalent to about 25 percent of global public defense budgets (Tian et al., 2023) and even surpasses the annual GDP of a global top-25 economic player like Norway. Against this backdrop, there emerged an increasing public interest in both intended and unintended social welfare effects of e-government investments initiatives, including its impact on corruption and bureaucracy reduction as well as public administration efficiency (Bertot et al., 2010; Elbahnasawy, 2014, 2021; Okunogbe and Pouliquen, 2022). One relatively underexplored area is the potential relationship between e-government investments and firm-level corporate tax planning activities.

Digital transformation within government operations is not only a matter of government administrative efficiency as it may also affect corporate financial decisions by reshaping the incentives and constraints firms face in tax planning and compliance. E-government investments enhance transparency and oversight by reducing information asymmetries as well as agency issues and therefore may have a direct effect on corporate tax strategies (e.g., see Beck et al., 2014). For corporations, government digitalization efforts mean that financial decisions, including tax reporting and the structuring of tax planning must increasingly align with a digitally integrated regulatory landscape. Analyzing the impact of e-government initiatives on corporate tax planning offers a valuable perspective on the broader link between public digitalization investments and corporate finance. Empirical evidence suggests that digital transformations in government services helps reducing tax evasion and compliance costs (Uyar et al., 2021, Okunogbe and Pouliquen, 2022). This highlights the significance of e-

government in shaping corporate financial outcomes, emphasizing its role as a pivotal factor in modern finance and economic policy.

At first sight, the net effect of digitalization trends on corporate tax planning opportunities is not obvious. On the one hand, the growing digital economy has enabled corporations to fully operate in their home country as well as in foreign countries, even in the absence of physical presence in those foreign countries. This feature has cultivated an environment that facilitates tax avoidance by taking advantage of the irrelevance of territories and national borders offered via online activities (see e.g., EC 2018/0072/CNS; Klassen et al., 2014; and Argilés-Bosch et al., 2020). In particular, especially firms with high organizational capital investments are well shaped to reap the benefits of corporate tax avoidance (e.g., Hasan et al. 2021). This is likely to hold because high organization capital stems from high investments into firm's internal knowledge, business processes and systems, which by themselves allow firms to better understand and exploit complex tax code differences as well as tax preferences.

Yet, on the other hand, the adoption of a higher level of digitalization by national governments serves the purpose of reducing levels of bureaucracy, improving data access and bettering public good provision's efficiency (Jansen and Ølnes, 2016). Therefore, e-government advancements are expected to affect the overall business environment in which firms operate substantially, making it primordial to understand better the role that e-government can play in shaping corporate tax decisions. Prior literature highlights the important role of information asymmetry and agency issues in corporate tax aggressiveness (see, e.g., Beck et al., 2014; Chen et al., 2011; Desai and Dharmapala, 2006). In the current study, we argue that e-government investments can enhance a country's transparency, thereby mitigating information asymmetries. This improvement should also benefit the financial sector by further

enhancing creditor protection (see De Vito and Jacob, 2023) and reducing lenders' risk exposure due to risk associated with high corporate tax aggressiveness (see Hasan et al., 2014).

Moreover, because especially high-organizational capital firms are more efficiently organized to identify tax-saving opportunities and can form an imminent threat for country tax revenues globally (EC 2018/0072/CNS; Hasan et al., 2021), governments are in pressing needs to know whether and how much costly e-governments advancements help curbing tax avoidance in general, and in high organizational capital firms in particular. In the current study, we therefore aim to bring large-scale, micro-economic evidence on whether and how e-government advancement investments can assist tax authorities in monitoring and identifying firms' tax planning strategies, ultimately reducing tax avoidance activities.

Our rationale is grounded in the observation that regulatory mechanisms play a pivotal role in shaping corporate tax planning behavior by altering its risk and benefit structure. Just as De Vito and Jacob (2023) argue and find that stronger creditor protection makes aggressive tax strategies riskier (hereby, reducing tax avoidance), e-government initiatives may serve as a regulatory mechanism that enhances transparency and oversight, discouraging firms from engaging in tax planning activities. Broadly speaking, countries' investments in information and communication technologies (ICTs), introduce increased levels of transparency and data exchange between governments and corporations and may ultimately pose a substantial challenge for firms seeking to conceal income or engage in aggressive tax planning practices, simply because their financial information becomes more easily accessible to tax authorities.

For our empirical analyses, we obtain firm financial data from Compustat Global and Compustat North America. We complement our firm-level financial dataset with the government digitalization information obtained from the survey questionnaire conducted by UN DESA.[1] The survey assesses the efficacy of e-government in providing public services and

[1] For more information see: https://www.un.org/en/desa/products/un-desa-databases.

monitors the advancement of e-government development in UN member states using the E-Government Development Index (EGDI). EGDI is a composite index with a range of scores from 0 (minimum) to 1 (maximum). It consists of three sub-indices, namely Telecommunications Infrastructure Index (TII), Human Capital Index (HCI), and Online Service Index (OSI). EGDI is a suitable metric for assessing e-government initiatives because it provides a comprehensive perspective on the external aspects of e-government, encompassing not only the implementation of ICT infrastructures within the government, but also the utilization, involvement, and provision of online services to relevant stakeholders.

We finally complement our dataset with data from the OECD's tax administration database that provides us with information about different features of tax enforcement. Our final sample consists of 82,523 firm-year observations pertaining to 10,936 unique firms from 56 countries for the period 2008-2021. Our panel data structure can incorporate several firm-level and country-level characteristics, as well as a large set of fixed effects, and allows for a granular analysis of the effect of governments' digitalization on corporate tax planning activities.

Our results show that a country's advancement of e-government is negatively associated with overall corporate tax avoidance. In economic terms, a one standard deviation increase in e-government investments corresponds to an increase of cash effective tax rates by about 14.6%. We obtain qualitatively similar yet economically stronger results when we use long-run period effective tax rates (ETR) measures as suggested by Dyreng et al. (2008) and when we control for lagged values of e-government. We next perform a mediation analysis to identify the channels through which e-government reduces corporate tax avoidance. Specifically, we examine key features of tax enforcement as identified in De Simone et al. (2024). Our findings suggest that the implementation of artificial intelligence (AI), machine learning and Robotic Process Automation, along with the overall tax enforcement budget, jointly account for a

significant portion, though not all, of the negative impact that e-government investments have on corporate tax avoidance.

Further, our cross-sectional tests reveal that the negative impact of e-government on firms' tax avoidance is especially pronounced in environments where firms possess higher levels of organizational capital as measured in Eisfeldt and Papanikolaou (2013). This suggests that firms with substantial organizational capital investments, and which historically were better able to also reap tax benefits from these investments (e.g., Hasan et al., 2021) are more effectively deterred from engaging in tax avoidance practices when fiercer e-government systems are put in place. The effectiveness of e-government initiatives in reducing tax avoidance, particularly among firms with significant investments into high levels of organizational capital, offers valuable public policy insights. It also highlights promising opportunities for preventing further tax revenue loss through enhanced government digitalization efforts.

An empirical challenge of our research design relates to properly isolating the effect of e-government investment on corporate tax planning activities and ensuring that our measurement does not suffer from various sources of endogeneity, including reverse causality and omitted variable bias. Our research design and identification strategy choices aim to mitigate endogeneity concerns in several ways. First, we control for firm-specific and country-specific factors that were identified in prior research as crucial factors of corporate tax avoidance to determine the impact of e-government advancement on corporate tax planning. Second, the multi-level structure of our international sample operating in a variety of industries allows us to include additional fixed effects to further ensure our empirical identification from omitted factors.

In addition, the results hold steady after a series of supplementary robustness tests. Specifically, our results hold for (1) different measures of tax avoidance, (2) different proxies

of e-government advancement, (3) alternative model specifications with various time-varying country characteristics, and (4) when employing different fixed effect structures to our estimations. Finally, our findings are also robust to using three different instrumental variables to overcome potential endogeneity concerns. We specifically instrument e-government with three World Development Indicators (WDI) variables: (i) a country's urbanization percentage (including deep lags), (ii) the proportion of mobile cellular subscriptions, and (iii) the percentage of internet users. While these instruments are expected to be associated with e-government adoption, we do not expect an ex-ante reason why they would directly correlate with a firm's decision to avoid taxes.

We contribute to the literature in several ways. *First*, to the best of our knowledge, our work is among the first studying how the digitalization efforts of governments relate to the overall level of corporate tax avoidance. That is, we expand the literature on the digitalization determinants of tax avoidance by highlighting the curbing role of a government's information and communication technologies (ICT) investment, rather than focusing on the firms' digitalization investment itself on tax avoidance (e.g., Klassen et al., 2014; Argilés-Bosch et al., 2020). *Second*, our work expands insights by De Simone et al. (2024) who use a machine learning approach to identify technological advancements of tax enforcement as an important factor explaining country-level GAAP ETR. Via mediation analysis, we identify that three specific tax enforcement features, namely (*i*) AI-machine learning, (*ii*) robotic process automation, and (*iii*) the total tax enforcement budget, explain a sizeable fraction of the negative effect that e-government has on firm-level tax avoidance. As such, our findings also provide large-scale evidence that digitalized analytical screening tools, enhanced by investments into risk profiling, may be associated with lower tax avoidance overall (Eberhartinger et al. 2023). *Third*, our analysis reveals that the negative effect of e-government on firms' tax avoidance is not uniform across all firms. Specifically, higher levels of

organizational capital amplify the curbing effect of e-government advancements on corporate tax avoidance, suggesting that governments may effectively gain by e-government investments in those sectors that traditionally benefited most from complex tax code interpretations.

In sum, our results speak broadly to policymakers that are interested in undoing or mitigating corporate tax avoidance practices. For instance, the European Commission, to regulate the new digital environment targeting fair corporate taxation, already issued the "*Proposal for a Council Directive laying down rules relating to the corporate taxation of a significant digital presence*" (see EC 2018/0072/CNS). We demonstrate that governments, through investments into digitalization and through specific channels, can mitigate corporate tax avoidance, particularly by prioritizing the enhancement of their online services.

The remainder of the paper is organized as follows. Section 2 develops the theoretical link between e-government advancements and corporate tax avoidance and formulates our hypotheses. Section 3 describes the data and empirical methodology. Section 4 reports the main empirical results and an overview of the robustness analyses. Finally, section 5 concludes.

2 Prior research and hypotheses development

2.1 E-government and firm's tax planning

Tax planning strategies become more and more complex and require more preparation in the digitalization era as the world becomes more digitally interconnected. Prior findings suggest that the development of Information and Communication Technology (ICT) infrastructures can help and aid firms' tax planning strategies. Klassen et al. (2014) and Argilés-Bosch et al. (2020), for instance, document that firms engaged in electronic commerce (e-commerce) systematically exhibit lower effective tax rates compared to traditional firms. Furthermore, Klein et al. (2021) investigate firm digitalization and show that ICT sophistication enhances a

firm's ability to exploit income shifting incentives. In addition, Brühne et al. (2024) suggest that technological change leads to increased tax avoidance by firms, either through a rise in intangible assets or by making firms more mobile. These findings are consistent with the idea internationalization through ICT allows firms to leap-frog the conventional business development stages and that tax planning strategies in particular can be pursued in a more agile way.

However, digitalization is not a privilege for corporations and can aid governments as well. Governments around the world have already embraced digitalization, yet at a different pace. The digitalization of governments (also called: e-government) is an outward-looking framework for understanding how government agencies use information and communication technology to interact with citizens, businesses, and other governmental organizations in the delivery of public services (Das et al., 2017, Elbahnasawy, 2021). A paradigm shift of this kind from paper-based to digital enables government services to become more easily connected and facilitates information exchanges between inter-governmental services as well as between the central government and corporations as well as individuals.

More advanced e-government investments benefit governments by enhancing technological infrastructures, expanding internet access, and promoting ubiquitous ICT usage. The first benefit for a government that adopts a higher level of digitalization is increased efficiency, productivity, and capacity for public services through automation and data-driven management, leading to increased revenue and growth (World Bank, 2016; Kochanova et al., 2020; Niebel, 2018). Furthermore, the integration of advanced data analytics within e-government platforms enhances the efficiency of processing vast quantities of data, empowering tax authorities to identify irregular patterns or inconsistencies within corporations' financial reports. Real-time reporting dynamics and the global reach of e-government systems further reduce opportunities for tax avoidance, as tax authorities can instantly monitor financial

transactions and facilitate international cooperation among diverse tax authorities, uncovering cross-border tax avoidance schemes.

Another advantage of e-government is increased transparency, fairness, and trust from businesses and citizens through the availability of a data exchange platform between tax authorities and firms (e.g.,Campbell and Hanschitz, 2018; Devereux and Vella, 2018; UNDESA, 2018; Lagodiienko and Yakushko, 2021). The latter may initiate social changes (see e.g., Weber, 1948; Nam, 2018) and potentially spur a lower incentive for investments into the informal economy, illegal tax evasion, and corruption (Uyar et al., 2021; Elbahnasawy, 2014, 2021). In an experimental setting on Tajikistan firms, Okunogbe and Pouliquen (2022) find that tax e-filings not only benefit corporations in that they spend 40 percent less time on filing but also that for firms previously known as evaders, e-filing doubles taxes paid. One potential explanation of the reason for such a positive effect of e-filing on tax avoidance can be explained by the fact that ICT works as a change agent, i.e., one that creates an atmosphere of openness that identifies and dampens non-compliant behavior (Bertot et al., 2010).

Given the arguments that e-government advancement can spur a nation's productivity and growth as well as increase the overall level of transparency, we conjecture that ICT investments can benefit a government in mitigating corporate tax planning activities and increase firms' tax compliance. Despite the seemingly important role of e-government in corporate tax planning, empirical research in this area is limited. Studies utilizing aggregated country-level data show that e-government adoption reduces illegal tax evasion and increases tax compliance and tax revenue within a country (Kochanova et al., 2020; Elbahnasawy, 2021; Uyar et al., 2021; Nimer et al., 2022). Kochanova et al. (2020) investigate the impact of electronic filing of taxes (i.e., e-filing) on tax compliance as well as corruption and find that e-filing reduces tax compliance costs and increases the tax revenue-to-GDP ratio. According to Uyar et al. (2021), the digitalization of government services has a greater impact on mitigating

illegal tax evasion in countries with higher ICT adoption. Elbahnasawy (2021) finds that e-government reduces the informal economy, and thus illegal tax evasion, within a country. Furthermore, Nimer et al. (2022) find that e-government, education quality, and internet access in schools, have a significant impact on reducing illegal tax evasion in a country. Finally, in a recent working paper, De Simone et al. (2024) identify country-level technological advancements such as artificial intelligence as an important determinant of a country's asset-weighted country-year average GAAP ETR.

Despite these interesting insights, however, there are still important elements on the e-government and tax avoidance paradigm that remain unanswered. One is that the research as of today typically observes aggregated country-level information to test the association between illegal tax evasion and investments into ICT and e-government. Yet, country-level data can say very little about firms' actual tax planning behavior. More granular firm-specific data are therefore needed to identify specific corporate tax planning behavior in relation to e-government advancement as well as to document the underlying mechanisms driving this.

The main objective of the current study is to examine the relation between country-level e-government adoption and corporate tax planning strategies, utilizing granular firm-level data. In particular, we conjecture that the digitalization advancement of e-government has a dampening effect on corporations' incentive to avoid taxes. Consequently, we conjecture that when a nation invests more in its e-government infrastructure, the average firm ETRs will be higher. As a result, we anticipate a negative relation between e-government advancement and a firm's tax avoidance. This logic results in our first hypothesis:

Hypothesis 1: *Ceteris paribus, the digitalization of governments (e-government) is negatively related to corporate tax avoidance.*

2.2 The mediating effect of tax enforcement

The adoption of e-government technologies has the potential to reduce tax avoidance through several mechanisms. Previous studies emphasize that enhanced tax enforcement is a key factor in improving taxpayer compliance and, consequently, reduces tax avoidance. Stronger enforcement increases the likelihood of detection and can be accompanied by more stringent penalties for non-compliance. Research on tax enforcement supports the view that tax authorities' efforts effectively deter individual taxpayers from engaging in tax avoidance or evasion (Atwood et al., 2012; Hoopes et al., 2012; Beuselinck et al., 2015; Nessa et al., 2020; De Simone et al., 2023, 2024).

Empirical research on tax enforcement and avoidance generally supports this notion, indicating that the detection capability of tax administrators can effectively deter corporations from engaging in tax avoidance (Atwood et al., 2012; Hoopes et al., 2012; Beuselinck et al., 2015; Nessa et al., 2020; De Simone et al., 2023; De Simone et al., 2024). Hoopes et al. (2012) observe for a sample of U.S. public firms companies over the period 1992 to 2008 that IRS audit efforts effectively decrease corporate tax avoidance. In an international context, Atwood et al. (2012) find that strong perceived tax enforcement reduces tax avoidance, with higher managerial compensation particularly increasing tax avoidance in weaker enforcement environments. Beuselinck et al. (2015) examine European multinationals over the period 1999-2008 and find that weak local tax enforcement facilitates income shifting to low-tax jurisdictions, and this tendency is particularly present among private multinationals where public scutiny is lower. These studies provide preliminary evidence on the critical role of robust tax enforcement in mitigating tax avoidance.

Building on these insights, recent literature dissects the components of tax enforcement to uncover how specific factors drive its effectiveness. For U.S. firms, Nessa et al. (2020) document that IRS resource components reflected by its total enforcement budget relates

positively to tax audit rates as well as the likelihood and magnitude of proposed deficiencies. De Simone et al. (2023) leverage international OECD tax administration data and show that increased home-country enforcement, as proxied by tax authority expenditures, curtails corporate tax avoidance, especially among domestic firms. Further expanding this view, De Simone et al. (2024) explore a global sample of 136 OECD country-years and conclude that investments into tax enforcement personnel but also technological advancements such as artificial intelligence relate to country-level GAAP effective tax rates.

In this paper, we argue that the improvement of a country's e-government is intricately linked with an enhanced tax authority's monitoring capacity. The real-time reporting dynamics and global reach of e-government systems diminish opportunities for tax avoidance, as tax authorities can instantaneously monitor financial transactions and even facilitate international cooperation among diverse tax authorities, enabling the uncovering of cross-border tax avoidance schemes. Thus, we expect that a country's investment in ICT technology will enhance, broadly speaking, the country's tax enforcement. To uncover the specific channels through which investments in ICT technology reduce corporate tax avoidance, we next follow a path (mediation) analysis, and we expect that certain features of tax enforcement (also see De Simone et al., 2024), such as the total expenditure for the tax authority (total tax enforcement budget), and technology (the use of AI-machine learning and robotic process automation) can mediate and explain a sizeable portion of the curbing effect that e-government has on corporate tax avoidance.

Hypothesis 2: *Ceteris paribus, tax enforcement features mediate the effect that digitalization of governments (e-government) has on corporate tax avoidance.*

2.3 Cross-sectional heterogeneity analysis

Prior literature indicates that intangible-intensive firms have more opportunities for tax avoidance due to the greater mobility of intangible capital compared to tangible capital (e.g.,

Dischinger and Riedel, 2011; Klassen and Laplante, 2012; De Simone et al., 2019). Additionally, the Arm's Length Principle faces challenges in determining the market price of these intangibles.

Next, we explore how companies' investment into intangibles affects the relationship between e-government and corporate tax avoidance. Instead of relying solely on the intangible asset proxy of the corporation, we adopt the classification system proposed by Lev et al. (2009) and rely on organizational capital as a major driver of corporate value and growth. Organizational capital refers to the combination of human skills and physical capital, which includes integrating technologies into systems to enhance operational efficiency, investment outcomes, and innovation performance, thereby creating a long-term competitive advantage (Eisfeldt and Papanikolaou, 2013; Hasan et al., 2021; Lev et al., 2009). Due to its tacit nature, organizational capital is not physically embedded, transferable, or fully documented. Consequently, a direct measure of a firm's organizational capital is not feasible, so researchers assess it through the firm's capabilities (Lev et al., 2009).

A growing body of literature examines the impact of organizational capital on various aspects of firm performance and strategy, including stock returns, labor market flexibility, mergers and acquisitions, and cost of bank loans (Eisfeldt and Papanikolaou, 2013; Leung et al., 2018; Li et al., 2018; Hasan et al., 2021; Danielova et al., 2023). Eisfeldt and Papanikolaou (2013) document that firms with higher levels of organizational capital realize higher returns on average. Leung et al. (2018) support these findings for a sample of firms from 20 OECD countries and find that the effect is most pronounced in countries with flexible labor markets. Li et al. (2018) examine a long string of US acquisition deals between 1984 to 2014 and observe that acquirers with higher organizational capital achieve better abnormal announcement period returns as well as superior post-merger operating and stock performances compared to their

competitors. Danielova et al. (2023) find that firms with higher organizational capital incur a lower cost on bank loans.

Other research documents that the firm-level organizational capital is also positively related to corporate tax avoidance. For example, the work of Hasan et al. (2021) explores the relationship between organizational capital (OC) and corporate tax avoidance and find that firms with higher levels of organizational capital engage in greater tax avoidance. They argue that OC, which encompasses a firm's internal knowledge, business processes, and systems, allows firms to better understand and exploit complex tax codes. This enables them to identify tax-saving opportunities more efficiently, thereby increasing tax efficiency and reducing their tax liabilities.

E-government initiatives enhance government monitoring capabilities, increasing the visibility and risks associated with aggressive tax avoidance strategies (e.g., Hoopes et al., 2012). For firms with high OC, which have the flexibility and resources to adapt, the heightened risk of detection may encourage a shift toward compliance (e.g., Lev et al., 2009; Hoi et al., 2013). These firms may find it more advantageous to leverage their OC to align with regulatory standards, as the potential cost and consequences of avoidance could outweigh any immediate tax savings. Rather than circumventing new regulations, high-OC firms may reallocate resources to reinforce compliance, viewing this approach as a more sustainable strategy under the increased scrutiny introduced by e-government.

High-OC firms are often better equipped to respond to regulatory changes, thanks to their enhanced adaptability (see, e.g., Brynjolfsson et al., 2002; Bird and Zolt, 2008). This adaptability not only enables them to integrate compliance measures more efficiently in response to e-government initiatives but also facilitates swift alignment with new regulatory standards. This synergy between OC and e-government enhances the reduction in tax avoidance.

Based on the above analysis, we formulate our next hypothesis as follows:

Hypothesis 3: *Organizational capital strengthens the negative relationship between government digitalization (e-government) and tax avoidance*.

3 Research design and data

3.1 Research design

We develop the following empirical model to test the first hypothesis about the effect of e-government adoption on tax avoidance:

$$Tax\ Avoidance_{ijt} = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 Tax\ enforcement_{jt} + \beta_3 Controls_{it} + \xi + \varepsilon_{ijt}. \quad (1)$$

In equation (1), the dependent variable, $Tax\ Avoidance_{ijt}$, is a tax avoidance proxy for firm i, located in country j, at time t.[2] For our baseline analysis, we use two versions of annual ETR: (i) $CASH\ ETR$ and (ii) $CURRENT\ ETR$, following previous studies (Klassen et al., 2014; Argilés-Bosch et al., 2020; Lanis and Richardson, 2015; Hasan et al., 2014; Graham et al., 2017), as well as their long run ETR versions. Our variable of interest is $EGDI_{jt}$, which is the e-government development index of country j at time t, obtained from the United Nations Department of Economic and Social Affairs (UNDESA). $EGDI$ is a composite index with three dimensions: (i) the online service index (OSI) that measures the provision of online services, (ii) the telecommunications infrastructure index (TII) that measures the adequacy of available infrastructures, and (iii) the human capital index (HCI) that measures human capital's ability to adopt ICT. In addition to *EGDI*, the survey tracks the use of ICT by the public to participate in decision-making, administration, and delivery of government services, as measured by the e-participation index (*EPI*). $Tax\ enforcement_{jt}$ is the level of tax enforcement in country j

[2] In the absence of a universal definition of the concept of tax avoidance (see for instance discussions in Dyreng et al., 2008; Hanlon and Heitzman, 2010; Cooper and Nguyen, 2020; Wang et al., 2020) we broadly define tax planning (or tax avoidance) as any financial-related action taken to reduce the firm's tax liability.

at time t. Consistent with previous studies in tax avoidance, $Controls_{it}$ denotes firm-year control variables, while ξ represents various fixed effects. We use firm, year, industry, industry-year and country fixed effects to mitigate concerns for omitted variables, while ε_{it} is the error term.

Next, we focus on the mediating effect of tax enforcement, therefore we modify Equation (1) into a set of three regressions as follows:

$$Channel_{jt} = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 Controls_{it} + \xi + \varepsilon_{ijt} \quad (2)$$

$$ETR_{ijt} = \gamma_0 + \gamma_1 EGDI_{jt} + \gamma_2 Controls_{it} + \xi + u_{ijt} \quad (3)$$

$$ETR_{ijt} = \delta_0 + \delta_1 EGDI_{jt} + \delta_2 Channel_{jt} + \delta_3 Controls_{it} + \xi + \varpi_{ijt} \quad (4)$$

We measure $Channel_{jt}$ using three potential tax enforcement features through which e-government could potentially affect tax avoidance. The first suggested mediator is the total expenditures on tax administration as a percentage of GDP ($Total\ tax\ enforcement\ budget$). Prior studies have repeatedly used this as a broad and general index that shows tax authorities' capacity (see e.g., De Simone et al., 2023). Focusing on the technological aspects of tax enforcement, which are likely directly connected to a government's investment in ICT, we also highlight the role of artificial intelligence (AI) and machine learning (ML) technologies, as well as robotic process automation (RPA) technologies, employed by tax authorities.

Furthermore, we also test the moderating effect of organizational capital. As a result, equation (1) takes now the following form:

$$ETR_{ijt} = \beta_0 + \beta_1 EGDI_{jt} + \beta_2 OC_{ijt} + \beta_3 EGDI_{jt} \times OC_{ijt} + \beta_4 Controls_{it} + \xi + \varepsilon_{ijt}. \quad (5)$$

To examine the moderating effect of organizational capital, we use the mean-adjusted stock of organizational capital (OC) as our primary proxy, computed by capitalizing SG&A expenses using the perpetual inventory method, following the approach of Eisfeldt and

Papanikolaou (2013) and Leung et al. (2018). The key coefficient, β_3, captures the moderating impact of organizational capital on the relationship between e-government and tax avoidance. Additionally, ξ represents the various fixed effects employed to control for unobserved heterogeneity.

3.2 Data and sample

We utilize international firm-level data from Compustat Global and Compustat North America spanning 2008 to 2021. This timeframe is selected because our variable of interest, EGDI, is consistently available every two years beginning in 2008, and the sample concludes in 2021 based on the most recent available data. Our sample selection is shown in Appendix Table A1. We follow Klein et al. (2020) and exclude firms from the utility and financial services sectors (SIC codes 4900-4999 and 6000-6999) because they are subject to different regulations. We also drop negative pre-tax income and negative income taxes because negative effective tax rates are difficult to interpret (Chen et al., 2019, Beer et al., 2020, Kubick et al., 2015). Following Dyreng et al. (2017), we require that each firm appears in our sample a minimum of five times to ensure within-firm variation (Li et al., 2020).[3] The final sample consists of 10,936 unique firms with 82,523 firm-year observations from 56 countries. Appendix Table A2 shows the distribution of firms across the countries. We observe that firms from China, India, and the United States account for more than half of our sample. Appendix Table A3 shows the industries to which the firms belong. Most observations (about 61%) come from the manufacturing sector, while 15% are from the services sector. Table 1 provides the definition of variables used in the empirical analysis, the data sources, and their expected signs.

(Insert Table 1 about here)

[3] Alternatively, we also require our sample to have a minimum of three-years observation following Li et al (2021) to avoid selection bias. The results for this analysis are available upon request.

3.2.1 Tax avoidance proxies

We measure firms' tax avoidance using annual $CASH\ ETR$ and $CURRENT\ ETR$ for the baseline analysis (Klassen et al., 2014; Argilés-Bosch et al., 2020; Lanis and Richardson, 2015; Hasan et al., 2014; Graham et al., 2017). Annual $CASH\ ETR$ is the ratio of income tax paid to pre-tax income. It reflects temporary (tax deferral strategies) and permanent differences and is unaffected by tax accruals. We use the $CURRENT\ ETR$ as an alternative to cash ETR for calculating total tax expense less deferrals (Hanlon and Heitzman, 2010, Donohoe and Knechel, 2014). In addition, we also construct three-year long-run cash and current ETR as alternative measures of tax avoidance to overcome significant year-to-year volatility of annual ETR (Balakrishnan et al., 2019, Dyreng et al., 2008, Graham et al., 2017, Klein et al., 2020). Following prior related literature, we adjust ETR to range between zero and one, setting values above one equal to one (Graham et al., 2017; Koester et al., 2017; Rego, 2003; Donohoe and Knechel, 2014). Higher values of ETR indicate lower tax avoidance and vice versa.

3.2.2 E-government proxies

To measure the government's digitalization, we rely on the e-government development index ($EGDI$), which we obtain from the biennial survey questionnaire conducted by UNDESA. The variable of interest measures the effectiveness of the e-government adoption in 193 United Nations members. We use data for the period from 2008-2021. The survey ranks countries on a scale from 0 to 1, where a higher value indicates higher e-government adoption. $EGDI$ gives a comprehensive view of the outward-looking framework of e-government. Not only it captures the utilization of technologies embodied in government but also encompasses the connection with external stakeholders such as citizens, firms, and other government agencies. To gain a complete picture, besides $EGDI$ as a proxy for e-government adoption we also use its sub-

indices, in our robustness tests. Namely, the Online Service Index (OSI), Telecommunications Infrastructure Index (TII), Human Capital Index (HCI) and E-participation Index (EPI).[4]

We argue that the greater the adoption of e-government, the easier is for the government to identify tax-avoiding firms. Therefore, we anticipate a positive relation between the government's digitalization and the firm's cash and current ETR.

3.2.3 Tax Enforcement proxies

We source our tax enforcement variable from the OECD Tax Administration Series for the time period between 2008-2021 for 37 OECD Countries and 19 Non-OECD Countries. For our mediating analysis, we examine three potential mediators. The first two technological features of tax enforcement that are likely directly linked to a government's investment in ICT are: (i) artificial intelligence and machine learning technologies (*AI & ML*), and (ii) robotic process automation technologies (*Robotics*) utilized by tax authorities (see De Simone et al., 2024).[5] We also use the total tax administration expenditures as a percentage of GDP ($Total\ tax\ enforcement\ budget$), to proxy the tax authority's capacity.

3.2.4 Organizational Capital proxies

Following the approach of Eisfeldt and Papanikolaou (2013) and Leung et al. (2018), we use the mean-adjusted stock of capitalized SG&A expenses to proxy organizational capital, employing the perpetual inventory method. The stock of a firm's organizational capital is calculated by recursively cumulating the deflated value of SG&A expenses as follows:

[4] Similar indexes that are comparable include the Eurostat Digital Economy index, which exclusively encompasses European countries and places greater emphasis on the digitalization of businesses and firms at the national level, the Global Competitiveness Index (GCI) from the World Economic Forum, which concentrates on ICT infrastructures and technological preparedness within a given country, and the World Bank Digital Adoption Index (DAI), which assesses the digital adoption across three economic dimensions - individuals, government, and businesses. However, it is important to note that the DAI is solely available for the years 2014 and 2016.

[5] The data for technological advancement are available starting from 2016 in the OECD Tax Administration Series 2023, which includes additional digitalization information on tax administration following the Inventory of Tax Technology Initiatives (ITTI). ITTI compiled the technology and digitalization information with the help of the International Survey on Revenue Administration (ISORA). For further details, refer to https://www.oecd.org/tax/forum-on-tax-administration/tax-technology-tools-and-digital-solutions/ (accessed on June 11, 2024).

$$OC_{it} = (1 - \delta_o) \times OC_{it-1} + \left(\frac{SG\&A_{it}}{cpi_t}\right), \quad (6)$$

where δ_o is the depreciation rate, and cpi_t is the US consumer price index. For a given firm, we begin the recursive estimation after it has first appeared in the Compustat Global or Compustat North America databases. For non-US firms, SG&A expenses are translated into US Dollars before deflating the SG&A value.

The initial stock of organizational capital is defined as follows:

$$OC_0 = SG\&A_1/(g + \delta_o). \quad (7)$$

We assume a 15% depreciation rate and a 10% growth rate (g) following Eisfeldt and Papanikolaou (2013) and Leung et al. (2018). The stock of organizational capital is scaled by total assets (OC/TA). For our robustness test, we alternatively scale it by Property, Plant, and Equipment (PPE).

3.2.5 Other control variables

We draw on prior literature on tax avoidance in identifying firm-level control variables. We control for *Tax enforcement*, using the number of tax administration staff, since prior literature (see e.g., Beuselinck et al., 2015, De Simone et al., 2023) shows that it crucially affects corporate tax planning strategies. We control for firm size using the logarithm of total assets ($Size$) (see e.g., Rego and Wilson, 2012, Kerr, 2019, Li et al., 2021, Klein et al., 2020, Klassen et al., 2014, among many others). *Growth* offers more opportunities to engage in tax avoidance and it is calculated as the ratio of revenues in year t to revenues in the preceding year (Graham et al., 2017, Argilés-Bosch et al., 2020). *Profitability* is proxied by Return on Assets (ROA) (see e.g., Argilés-Bosch et al., 2020), and it is calculated as the ratio of pre-tax income to total assets.

Leverage is a proxy for risk exposure, and it is calculated as the ratio of total long-term debt to total assets (Balakrishnan et al., 2019). We use the natural logarithm of the number of

years a firm has been listed in Compustat (Age) to control for the experience firms gain over time (see e.g., Donohoe and Knechel, 2014, Balakrishnan et al., 2019). Following previous literature, we also control for Net Operating Loss Carry-forward ($NOLREV$), while we take into consideration if loss carry-forward is positive at the beginning of year t, ($Loss$) (e.g., Klassen et al., 2014; Graham et al., 2017; Argilés-Bosch et al., 2020). Importantly, we control for intangible intensity ($Intangible$), R&D expenses (RnD),[6] and inventory intensity ($Inventory$) that prior literature identifies as significant (see e.g., Argilés-Bosch et al., 2020, Kerr, 2019, Klassen et al., 2014, Klein et al., 2020). To take into consideration investments in advanced technologies (including digital technologies), we control for firms' Property, Plant, and Equipment (PPE) (Argilés-Bosch et al., 2020, Klein et al., 2020). Finally, we control for the presence of BIG4 auditors ($BIG4$), stock return volatility ($Volatility$), advertising expense ($Advertising$) to proxy for the non-tax cost of tax avoidance[7] and *Capital expenditure (CAPEX)* (Rego and Wilson, 2012; Klassen et al., 2014; Koester et al., 2017; Balakrishnan et al., 2019; Li et al., 2021).

We present the descriptive statistics in Table 2. The average $CASH\ ETR$ and $CURRENT\ ETR$ are 31.2% and 21.4, while their long-run values are 29.1% and 19.7%, respectively.

(Insert Table 2 about here)

Table 3 displays Pearson correlations. Most of the variables present statistical associations that are statistically significant. Our variable of interest has a positive correlation to the tax avoidance proxies (annual and long-run cash ETR and current ETR). In addition, it shows a negative and significant relation to a set of tax aggressiveness variables (annual and

[6] Based on prior research, we assigned a value of zero to this variable whenever it was missing (Koester et al., 2017, Li et al., 2021, Klein et al., 2020), and we anticipate a negative relation with the firm's ETR.
[7] Since the data on advertising expenses is only available for a small number of firms, we follow Dyreng et al. (2010) and set missing values to 0.

long-run GAAP, cash, and current ETR differences). We test for the multicollinearity of these variables using variance inflation factor (VIF). We find that the VIF factor is below ten, thus we conclude that our model is not affected by multicollinearity (O'Brien, 2007).

(Insert Table 3 about here)

4 Results

4.1 Relation between e-government and tax avoidance

We begin by reporting the baseline estimate for the relation between e-government adoption ($EGDI$) and tax avoidance in Table 4. In our baseline estimation, we start with the annual $CASH\ ETR$ as the dependent variable. The results show that the coefficient of $EGDI$ when the dependent variable is the annual $CASH\ ETR$ is positive and significant at the 1% level. In economic terms, a one standard deviation increase in $EGDI$ would increase $CASH\ ETR$ by about 4.55 percentage points. Given that the mean value of the pretax earnings for the average firm in our sample equals $240.8 million, this translates into around 11 million USD more in paid taxes per firm and year.[8] Moreover, our results are qualitatively similar when we use the $CURRENT\ ETR$ as an alternative to cash ETR for calculating total tax expense less deferrals (Hanlon and Heitzman, 2010, Donohoe and Knechel, 2014). Additionally, we include pre-tax income growth (columns 7-8) and the statutory tax rate (columns 9-10) as control variables to ensure that our findings are not influenced by pre-tax income growth or differences in statutory tax rates. The results remain consistent.

(Insert Table 4 about here)

To mitigate year-to-year volatility in the annual ETR, we also conducted a test using the three-year (long-run) cash and current ETR. The results, presented in Appendix Table A4,

[8] The calculation we perform is as follows: the coefficient of $EGDI$ (i.e., 0.175) multiplied by sample's standard deviation (i.e., 0.26) equals 0.0455. We then multiply this number with the sample mean of pretax earnings (i.e., 240.8 million USD), resulting in 11 million USD.

consistently show a positive and significant coefficient, aligning with our previous findings. Even though we provide specifications that include *Tax Enforcement*, along with firm, year, industry, or industry-year, and country fixed effects in our estimations, one might argue that time-varying country characteristics could influence our results. To address these concerns, we added country-specific controls known to impact tax avoidance based on prior studies. Therefore, in addition to the various controls and fixed effects already used, we also controlled for bureaucracy (*Bureaucracy*), corruption (*Corruption*), and economic development (*GDPPC*) within a country. The findings, shown in Appendix Table A5, indicate that the results remain qualitatively similar.

Next, we examine the robustness of our baseline findings, utilizing one-year (see Appendix Table A6 Panel B) and two-year (see Appendix Table A6 Panel C) lagged values of the e-government measure. We use lags (i) to investigate whether any prior enhancement in e-government continues to have an impact in the subsequent years and (ii) to mitigate potential endogeneity issues stemming from reverse causality. Crucially, the outcome of this examination not only indicates the significance of EGDI from previous years but also reveals a strengthening impact of EGDI improvement on corporate tax avoidance with each passing year. At first glance, these findings robustly support our Hypothesis 1. The rise in e-government corresponds to an increase in firm ETR; in essence, the adoption of e-government diminishes tax avoidance.

Finally, we carry out a supplementary test to examine separately each of EGDI's sub-components i.e., Online Service Index (OSI), Telecommunication Infrastructure Index (TII), Human Capital Index (HCI), as well as E-Participation Index (EPI). Our focus is to check which one drives our findings. The results in Table 5 show that all the sub-components have a positive effect on firms' ETR. However, the effect of the Online Service Index (OSI) by far has a stronger statistical and economic significance than the rest.

(Insert Table 5 about here)

4.2 Instrumental variables approach

Although the results of our estimations using different dependent variables, various fixed effects (firm, year, industry or industry-year and country), and relevant time-varying country characteristics support our first hypothesis, they should be interpreted with caution. Endogeneity may arise when we attempt to estimate the causal relation between e-government and firm tax planning activities. Omitted variables that explain tax avoidance but are not included in our models are one potential source of endogeneity. Furthermore, the e-government ($EGDI$) variable in our empirical analysis might be open to measurement error, resulting in biased and inconsistent estimates. Another source of endogeneity is reverse causality. Even though we test for one and two-year lagged e-government, someone could argue that a government's decision to change the level of e-government is caused by companies' systematic tax behavior rather than the other way around. We use the instrumental variables (IV) approach to deal with endogeneity. In mathematical terms, the 2SLS model we use is as follows:

$$ETR_{ijt} = \beta_0 + \beta_1 \widehat{EGDI}_{jt} + \beta_2 CONTROLS_{it} + \xi + \varepsilon_{ijt}, \quad (8)$$

$$EGDI_{ijt} = \gamma_0 + \gamma_1 IV_{jt} + \gamma_2 CONTROLS_{it} + \varsigma_{ijt}. \quad (9)$$

To identify e-government we need an exogenous variable that is correlated with [it] but it does not directly impact a firm's tax avoidance and tax aggressiveness. That is, the effect of the instrument on the dependent variables should be only through e-government adoption. We use two sets of instruments. The first set includes the level of urbanization in a country, covering both current levels and deep lags. The second set includes mobile cellular subscriptions per 100 people and the percentage of internet users. All variables are sourced from the World Development Indicators.

Regions with higher levels of urbanization tend to have higher incomes (Bloom et al., 2008). The density of urban areas fosters knowledge exchange and innovation (Brunt and

Garcia-Penalosa, 2022). As a result, urbanization naturally promotes greater investment in e-government, as urban populations generate substantial demand for efficient public services and strong infrastructure (Henderson and Wang, 2005). As cities expand, governments face mounting pressure to manage resources effectively, reduce administrative complexities, and meet the expectations of densely populated, often digitally savvy citizens. Urban areas typically have better internet connectivity, a more tech-literate population, and concentrated economic activity, making them ideal settings for digital public services. Thus, e-government investment aligns with the complex administrative needs of urban populations, positioning urbanization as a key driver of digital government initiatives.

Urbanization itself does not directly influence corporate tax avoidance, as it primarily reflects population density and economic concentration rather than corporate tax behaviors. However, urbanization indirectly affects tax avoidance through its impact on e-government investment. Higher urbanization levels drive governments to invest in digital public services to meet the administrative demands of a concentrated urban population. These e-government investments, in turn, enhance tax oversight, transparency, and enforcement capabilities, which can reduce corporate tax avoidance. Thus, while urbanization creates the conditions for e-government development, it is the enhanced digital infrastructure and regulatory oversight from e-government initiatives that ultimately impact corporate tax behavior.

For the two other instruments, i.e., mobile cellular subscriptions per 100 people and the percentage of internet users, we argue that in countries where IT infrastructure is more advanced, governments can set up online public services easier. While these instruments are expected to be correlated with e-government adoption, we do not see a reason why they should directly correlate with a firm's decision to avoid taxes. The identifying assumption in our IV analysis is that after controlling for firm, year, industry, industry-year and country fixed effects,

our instruments enter exogenously in e-government adoption. We perform two-stage least squares (2SLS) estimations and present our results in Tables 6 & 7.

(Insert Tables 6 & 7 about here)

The results from the instrumental variables approach confirm the baseline analysis. In the first stage, the instruments enter with positive and significant coefficients, suggesting that in countries with higher urbanization, greater cellular subscription usage, and a higher percentage of internet users contribute to an increased level in the e-government index. In addition, the first-stage F-statistic obtained for these instruments is higher than the critical values from Stock and Yogo (2002), indicating that our instruments are strong. In the second stage, the endogenous variable, e-government, is replaced with its fitted values, and we then regress the dependent variables (i.e., the tax avoidance proxies) on these fitted values. We find that the fitted value for e-government has a positive and statistically significant coefficient. The results are consistent when we swap *CASH ETR* for *CURRENT ETR*, as well as when we use various fixed effects.[9]

4.3 Mediating analysis of tax enforcement

Having demonstrated that the adoption of e-government reduces tax avoidance in our global sample, we next explore the potential channels through which e-government impacts corporate tax avoidance. To this end, we conduct a mediation analysis. It can be argued that a country's investment in ICT technology broadly enhances tax enforcement by improving, among other things, tax authorities' monitoring capacity. Several mechanisms may explain how a higher level of e-government leads to lower corporate tax avoidance. In this study, we examine three specific features of tax enforcement that could potentially explain the negative effect of e-government on tax avoidance.

[9] The 2SLS approach also holds when we use long run cash ETR and current ETR, lagged values (one or two years) for e-government, or when we alternate the composite e-government proxy with its sub-indices. The findings are consistent showing towards the same direction and are available upon request.

The first two are directly linked to the technological features of tax enforcement (see De Simone et al., 2024). Namely, the artificial intelligence and machine learning technologies ($AI\ \&\ ML$), as well as the robotics programming automation technologies ($Robotics$) that tax authorities utilize. The third potential channel is the total expenditures on tax administration as a percentage of GDP ($Total\ tax\ enforcement\ budget$), which generally captures the tax authority's capacity and has been used in prior studies (e.g., see De Simone et al., 2023).[10]

In Table 7, we report the results of the mediation analysis about the use of artificial intelligence and machine learning. Columns 1 and 4 show that $AI\ \&\ ML$ and $EGDI$ are strongly correlated. Columns 2 and 5 show the initial regression, where the coefficient of e-government ($EGDI$) equals 0.179 for the case of $CASH\ ETR$ and 0.092 for the case of $CURRENT\ ETR$. Both are strongly significant at the 1% level. Finally, columns 3 and 6 include both EGDI and the mediator, $AI\ \&\ ML$. The inclusion of $AI\ \&\ ML$ mediates the initial relationship, reducing the coefficient of EGDI. For the case of $CASH\ ETR$, the new coefficient is 0.113, i.e., 36.9% smaller compared to the initial 0.179. For the case of $CURRENT\ ETR$, the new coefficient is 0.045, i.e., 51.1% smaller compared to the initial 0.092.

(Insert Table 8 about here)

Similarly, Table 8 reports the results of the mediation analysis, where the mediator is the use of robotics programming automation technologies. Again, the mediator ($Robotics$) and the independent variable ($EGDI$) are correlated (see columns 1 and 4), while the inclusion of the mediator in the regression (see columns 3 and 6) reduces the coefficient of $EGDI$. In

[10] Following prior studies (e.g., see Baron and Kenny, 1986; Hammersley, 2006; Lang et al., 2012; Shevlin et al., 2020 among many others), a valid mediation analysis requires: First, the dependent variables ($CASH\ ETR\ and\ CURRENT\ ETR$) to be related with the independent variable ($EGDI$). Second, the expected mediators ($AI\ \&\ ML$, $Robotics$, and $Total\ tax\ enforcement\ budget$) to be related with the independent variable ($EGDI$). Third, the mediators ($AI\ \&\ ML$, $Robotics$, and $Total\ tax\ enforcement\ budget$) are correlated with the dependent variable ($EGDI$). Finally, the mediator and initially independent variable are included in the same regression along with the dependent variable and the mediator ($AI\ \&\ ML$, $Robotics$, and $Total\ tax\ enforcement\ budget$) mediates the initial relationship between e-government ($EGDI$) and tax avoidance (ETR).

particular, when the dependent variable is $CASH\ ETR$ the coefficient of EGDI is 0.146 (see column 3), i.e., 18.4% smaller compared to its value before the mediation (see column 2), while in the case of $CURRENT\ ETR$ it is 0.055 (see column 6), i.e., 16.3% smaller compared to its value before mediation (see column 5).

(Insert Table 9 about here)

Finally, Table 9 presents the results of the mediation analysis regarding the use of total expenditures on tax administration as a percentage of GDP. Again, the mediator ($Total\ tax\ enforcement\ budget$) and independent variable ($EGDI$) are strongly correlated (see columns 1 and 4), while the inclusion of the mediator in the regression (see columns 3 and 6) reduces the coefficient of $EGDI$. In particular, in the case of $CASH\ ETR$ the coefficient of EGDI is 0.126 (see column 3), i.e., 29.6% smaller compared to its value before the mediation (see column 2), while in the case of $CURRENT\ ETR$ the value is 0.067 (see column 6), i.e., 27.2% smaller than its value before mediation (see column 5).

(Insert Table 10 about here)

The mediation analysis so far suggests that artificial intelligence and machine learning technologies (*AI & ML*), robotics programming automation technologies (*Robotics*), and total expenditures on tax administration as a percentage of GDP (*Total tax enforcement budget*) indeed have a strong mediation effect in the relationship between e-government and tax avoidance. In terms of sheer mediation effect, we find *AI & ML* to have a pivotal role (strongest mediation) followed by *Total tax enforcement budget* and *Robotics*.

To further understand the proposed underlying mechanisms and provide an additional robustness test for our mediation analysis, we simultaneously employ the three mediators in a "horserace" specification. Table 3 demonstrates that the correlations between our mediators are relatively low (1.8%, 3.3%, and 22.5%), indicating a low risk of multicollinearity, which allows us to include all mediators in the same regression. The results, presented in Table 10, show that

as we sequentially add the three mediators, the coefficient of *EGDI* consistently decreases. Importantly, across all specifications, the effect of the mediators remains highly significant at the 1% level. When incorporating the full range of mediators (see columns 4 and 8), the coefficient of *EGDI* is significantly lower compared to its value before mediation (see columns 1 and 5). Specifically, in column 4, the coefficient of e-government for the *CASH ETR* case is reduced to 0.074 from 0.179, while in column 8, the coefficient for *CURRENT ETR* decreases to 0.025 from 0.092.

We glean additional insights from the mediation analysis. First, the results demonstrate a statistically significant direct relationship between the adoption of e-government and tax avoidance, independent of the mediating factors used. Second, the e-government–tax avoidance relationship is not fully mediated, implying that other potential, unidentified mediating pathways may also exist.[11]

(Insert Table 11 about here)

4.4 The Moderating effect of organizational capital

Our findings thus far indicate that e-government negatively impacts firms' tax avoidance. Next, we examine whether organizational capital influences the effect of e-government on tax avoidance (see Hypothesis 3). Table 12 illustrates the moderating effect of organizational capital (measured by total assets) on the relationship between e-government and firm tax avoidance. The coefficient of $EGDI$ on ETR measures is positive and significant, suggesting that e-government reduces tax avoidance for the average firm in our sample. The coefficient of

[11] In untabulated tests, we have also tested for potential mediators using human capital features of tax enforcement. Our findings suggest that the human capital of tax authorities does not have a direct mediating effect. The absence of direct mediation does not mean there is no mediation effect. It might exist mediation effect conditional to other variable(s). Importantly, there might exist some moderated-mediation effect. Unfortunately, more granular tax administration data are needed for a more detailed and complex mediation analysis. For example, the technological advancement features of tax enforcement are only available from 2016 and onwards. The latter, in combination with the fact that the human capital features of tax enforcement exhibit a high correlation with the mediating variables used (see Pearson correlation for these variables in Table 3), do not provide us leeway for more complicated mediation models due to the risk of multicollinearity.

OC on ETR measures is negative and significant, suggesting that organization capital increases tax avoidance for the average firm in our sample. Focusing on the latter, the positive and strongly significant coefficient of the interaction term ($EGDI \times OC$) indicates that the adoption of e-government reduces the level of tax avoidance even for firms with higher organizational capital. This consistency holds when we scale using PPE (see Appendix Table A7) or use a dummy variable for intangible assets (see Appendix Table A8).

This finding is in favor of hypothesis 3. This new finding suggests that a higher level of e-government adoption can potentially decrease corporate tax avoidance even under the more challenging conditions where a firm exhibits higher organizational capital and thus exhibits a higher intangibility.

(Insert Table 12 about here)

5 Conclusion

We examine the impact of e-government adoption on firms' tax planning activities using firm-level financial data from 56 countries between 2008 and 2021. Our findings indicate that increased e-government adoption reduces firms' tax avoidance, with this effect being more pronounced in countries with a high Online Service Index (OSI). We conduct a series of robustness tests using various alternative proxies for tax avoidance, including long-run measures. For identification purposes, we employ an instrumental variables approach, and our results remain consistent, if not stronger. Furthermore, we demonstrate significant mediation effects in the relationship between e-government and corporate tax avoidance, through technological advancements (AI & ML and Robotics) and tax spending in tax authorities. Additionally, we find that organizational capital plays a crucial moderating role, amplifying the effect of e-government.

Our study does not come without limitations. One issue in the OECD Tax Administration Data series is that the technological advancement features of tax enforcement

i.e., artificial intelligence and machine learning as well as Robotics programming are only available from 2016 onwards. The latter leads to a relatively low variation available for our mediation analysis. However, such a limitation could provide opportunities for future research. More granular tax administration data could provide the opportunity to examine more complicated path analysis including moderated-mediations, and thus to shed further light on the remaining unexplained part of the effect that e-government has on corporate tax avoidance.

Future studies could also explore the effect of e-government on various forms of tax planning activities. Furthermore, more granular data on e-government adoption at the firm or industry level could provide deeper insights into the specific mechanisms through which e-government impacts tax avoidance. Researchers might also consider longitudinal studies to capture the dynamic aspects of e-government implementation and its long-term effects on tax compliance. Additionally, examining the interaction between e-government adoption and other institutional factors, such as regulatory quality or political stability, could yield a more comprehensive understanding of its impact on corporate tax behavior.

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Table 1
Variable descriptions

Variables	Description	Sources	Sign
Tax Avoidance Variables			
GAAP ETR	The Annual GAAP Effective Tax Rate is defined as the total tax expense (*txt*) divided by pre-tax accounting income (*pi*). It ranges between 0-1.	Compustat	
CASH ETR	The Annual Cash Effective Tax Rate is defined as the tax paid (*txpd*) divided by pre-tax accounting income (*pi*). It ranges between 0-1.	Compustat	
CURRENT ETR	The Annual Current Effective Tax Rate is defined as the current income tax expense (*txc*) divided by pre-tax accounting income (*pi*). It ranges between 0-1.	Compustat	
GAAPLR ETR	The Long Run GAAP Effective Tax Rate is defined as the sum of three-years (t to t-2) of total tax expense (*txt*) divided by the sum of three-years (t to t-2) of total pre-tax accounting income (*pi*). It ranges between 0-1.	Compustat	
CASHLR ETR	The Long Run Cash Effective Tax Rate is defined as the sum of three years (t to t-2) of total tax paid (*txpd*) divided by the sum of three years (t to t-2) of total pre-tax accounting income (*pi*). It ranges between 0-1.	Compustat	
CURRENTLR ETR	The Long Run Current Effective Tax Rate is defined as the sum of three years (t to t-2) of the total current income tax expense (*txc*) divided by the sum of three years (t to t-2) of the total pre-tax accounting income (pi). It ranges between 0-1.	Compustat	
Variables of interest			
EGDI	E-Government Development Index. A composite index based on the weighted average of three normalized indices, namely OSI, TII, and HCI. It is used to measure the readiness and capacity of national institutions to use ICTs to deliver public services.	UNDESA	+
OSI	Online Service Index. This is a sub-index of EGDI. It assesses the national online presence of UN member states.	UNDESA	+
TII	Telecommunications Infrastructure Index. This is a sub-index of EGDI that assesses the status of the development of telecommunication infrastructure.	UNDESA	+
HCI	Human Capital Index. This is a sub-index of EGDI that assesses the human capital ability to adopt ICT.	UNDESA	+/-
EPI	E-Participation Index. A supplementary index to the UN E-Government Survey that focuses on the government's use of online services in providing information to its citizens, interacting with stakeholders, and engaging in decision-making processes.	UNDESA	+
Moderating and mediating variables			
Organizational Capital	Mean-adjusted stock of organization capital, computed as the capitalized SG&A expenses using the perpetual inventory method following Leung et al (2018). A firm's stock of Organization Capital is computed by recursively cumulating its deflated value of SG&A expenses. For non-US firms, all SG&A expenses are translated into US Dollars before deflating. A depreciation rate of 15% is used and the growth rate is assumed to be 10%.	Compustat	
Intangible Assets (dummy)	Dummy variable taking value 1 if a firm has intangible assets, 0 otherwise	Compustat	
Total tax enforcement budget	Proxy for tax enforcement (financial resources). Measured as total expenditures on tax administration divided by GDP, following De Simone et al (2024)	OECD Tax Administration	

(Table 1 continues on next page)

(Table 1 continues from previous page)

Pct_change enforcement	Proxy for tax enforcement (financial resources). Measured as Inflation adjusted percent change in tax expenditure, following De Simone et al (2024)	OECD Tax Administration	
AI & ML	Proxy for tax enforcement (technology). Measured as dummy variable, 0 is if the country has not yet applied the artificial intelligence (AI) and machine learning (ML) technologies and 1 if the technologies are in use.	OECD Tax Administration	
Robotics	Proxy for tax enforcement (technology). Measured as dummy variable, 0 is if the country has not yet applied the robotics programming automation technologies and 1 if the technologies are in use.	OECD Tax Administration	
Control variables			
Size	Firm's size as proxied by log of total assets (*at*)	Compustat	-
Profitability	Change in revenue. This variable is defined as: $(revt_t - revt_{t-1})/revt_{t-1}$	Compustat	+/-
Leverage	Total long-term debt (*dltt*)/total assets (*at*)	Compustat	-
Age (log)	Firm's age is proxied by the log of the number of years a firm has been listed on Compustat.	Compustat	+/-
Net Operating Loss Carry-forward (NOLREV)	Existence of previous loss, calculated as the sum of 4 years of profit/revenue.	Compustat	+
Loss	Dummy variable taking value 1 if a firm's income before extraordinary items (*ib*) is less than zero in the current year and 0 otherwise.	Compustat	+
Intangible	Intangible intensity is proxied by the ratio of intangible assets (*intan*) scaled by total assets (*at*).	Compustat	-
R&D (rnd)	R&D intensity is calculated as research & development expense (*xrd*) scaled by total assets (*at*).	Compustat	-
Inventory	Inventory intensity is proxied by the ratio of total inventories (*invt*) scaled by total assets (at).	Compustat	+
Property, Plant, and Equity (PPE)	Net property, plant, and equipment (*ppent*) scaled by total assets (at).	Compustat	-
BIG4	An indicator taking value 1 if a firm is audited by the BIG4 auditing services (Deloitte, KPMG, Ernst and Young, and PwC), 0 otherwise.	Compustat	+/-
Volatility	This is the natural logarithm of the standard deviation of sales for the past 5 years.	Compustat	-
Selling, General and Administrative Expense (*sga*)	This equals the ratio of selling, general and administrative expenses scaled by total sales. Compustat: *xsga/sale*.	Compustat	-
Advertising	Advertising expenses scaled by total sales. Compustat: xad/sales	Compustat	-
Capital Expenditure (capex)	Total capital expenditure (capx) divided by total sales(sale).	Compustat	-
lTAXSTAFF	Number of staff at tax administration	OECD Tax Administration	
PI_growth (log)	Pretax Income Growth (log) is pretax income (t) - pretax income (t-1) scaled by pretax income (t-1)	Compustat	
STR	Statutory tax rate of each country	OECD, KPMG, Tax Foundation	
Instruments			
Urbanization	The percentage of urbanization in a specific country.	WDI	
Mobile	Mobile cellular subscription per 100 people.	WDI	
Internet	Percentage of the population using the internet.	WDI	

Table 2
Descriptive Statistics

Variables	Observations	Mean	SD	Min	p25	p50	p75	Max
Tax Avoidance (firm-level)								
CASH ETR	82,523	0.312	0.260	0.000	0.145	0.257	0.399	1.000
CASHLR ETR	82,523	0.291	0.226	0.000	0.157	0.254	0.365	1.000
CURRENT ETR	82,523	0.214	0.170	0.000	0.114	0.203	0.290	1.000
CURRENTLR ETR	82,523	0.197	0.139	0.000	0.106	0.196	0.280	1.000
Variables of Interest (Country-level)								
EGDI	82,523	0.665	0.169	0.087	0.536	0.678	0.823	0.976
OSI	82,523	0.735	0.202	0.000	0.543	0.768	0.906	1.000
TII	82,523	0.490	0.247	0.043	0.304	0.473	0.739	0.998
HCI	82,523	23.37	453.9	0.000	0.686	0.774	0.888	9,141
EPI	82,523	0.699	0.266	0.024	0.529	0.780	0.921	1.000
Moderating and Mediating Variable								
Organizational Capital	67,419	0.000	0.991	-3.328	-0.632	-0.304	0.363	17.481
Intangible Assets (dummy)	82,523	0.904	0.295	0.000	1.000	1.000	1.000	1.000
Tax enforcement_total budget	82,523	0.000	0.000	0.000	0.000	0.000	0.000	0.014
Pct_change enforcement	67,658	-0.993	0.018	-1.000	-1.000	-0.999	-0.994	-0.872
AI & ML (dummy)	43,422	0.231	0.421	0.000	0.000	0.000	0.000	1.000
Robotics (dummy)	43,422	0.275	0.446	0.000	0.000	0.000	1.000	1.000
Control Variables								
Size	82,523	7.680	2.124	2.962	6.325	7.544	8.846	15.21
Growth	82,523	0.132	0.257	-0.438	0.000	0.087	0.211	1.407
Profitability	82,523	0.095	0.074	0.003	0.044	0.078	0.125	0.402
Leverage	82,523	0.100	0.127	0.000	0.000	0.045	0.162	0.547
Age	82,523	5.881	3.452	1.000	3.000	5.000	9.000	13.00
log(age)	82,523	1.541	0.750	0.000	1.099	1.609	2.197	2.565
NOLREV	82,523	0.308	0.276	-0.134	0.115	0.240	0.425	1.387
Loss	82,523	0.010	0.099	0.000	0.000	0.000	0.000	1.000
Intangible	82,523	0.105	0.156	0.000	0.003	0.034	0.133	0.668
R&D (rnd)	82,523	0.012	0.024	0.000	0.000	0.000	0.016	0.139
Inventory	82,523	0.140	0.123	0.000	0.044	0.117	0.202	0.595
PPE	82,523	0.263	0.192	0.003	0.108	0.224	0.379	0.830
BIG4	82,523	0.353	0.478	0.000	0.000	0.000	1.000	1.000
Volatility (log)	82,523	5.403	2.271	0.167	3.948	5.280	6.683	13.40
SGA Expense	82,523	0.173	0.132	0.000	0.078	0.140	0.232	0.645
Advertising	82,523	0.001	0.006	0.000	0.000	0.000	0.000	0.041
Capital Expenditure (capex)	82,523	0.077	0.105	0.000	0.018	0.041	0.091	0.659
Tax Staff (log)	82,523	11.39	1.798	4.575	10.37	11.24	13.47	13.53
PI_growth (log)	40,943	-1.309	1.416	-12.599	-2.086	-1.266	-0.483	7.586
STR	82,523	0.271	0.058	0.090	0.250	0.250	0.302	0.395
Instruments (Country-level)								
Urbanization (at time *t*)	82,523	63.50	18.38	26.11	51.77	60.31	80.98	100.0
Urbanization (lag at time *t-5*)	82,523	60.28	19.61	23.97	46.19	55.50	80.10	100.0
Urbanization (lag at time *t-10*)	82,523	56.93	21.10	22.05	39.78	49.23	79.06	100.0
Mobile	82,523	106.9	26.11	43.12	88.31	107.7	121.8	186.2
Internet	82,523	59.29	24.66	5.120	43.00	64.11	80.72	99.01

Table 3
Pearsons Correlations

Variables		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
CASH_ETR	[1]	1																					
CASHLR_ETR	[2]	0.843[a]	1																				
CURRENT_ETR	[3]	0.511[a]	0.410[a]	1																			
CURRENTLR_ETR	[4]	0.395[a]	0.467[a]	0.807[a]	1																		
EGDI	[5]	0.043[a]	0.071[a]	0.191[a]	0.251[a]	1																	
OSI	[6]	0.182[a]	0.232[a]	0.252[a]	0.339[a]	0.818[a]	1																
TII	[7]	0.043[a]	0.064[a]	0.186[a]	0.233[a]	0.957[a]	0.689[a]	1															
HCI	[8]	-0.003	-0.009[a]	0.016[a]	0.016[a]	0.058[a]	0.027[a]	0.067[a]	1														
EPI	[9]	0.239[a]	0.284[a]	0.235[a]	0.307[a]	0.711[a]	0.900[a]	0.618[a]	-0.003	1													
Organizational Capital	[10]	-0.029[a]	-0.013[a]	-0.048[a]	-0.053[a]	-0.099[a]	-0.148[a]	-0.122[a]	0.013[a]	-0.168[a]	1												
Intangible Assets (dummy)	[11]	0.055[a]	0.063[a]	-0.038[a]	-0.052[a]	0.148[a]	0.080[a]	0.155[a]	0.007[b]	0.099[a]	-0.022[a]	1											
Size Pillar 2	[12]	0.038[a]	0.056[a]	0.138[a]	0.173[a]	0.291[a]	0.207[a]	0.284[a]	0.004	0.169[a]	-0.115[a]	0.139[a]	1										
Tax enforcement_tot budget	[13]	0.003	0.000	0.025[a]	0.028[a]	-0.040[a]	-0.056[a]	-0.026[a]	-0.002	-0.039[a]	-0.028[a]	-0.047[a]	-0.005	1									
Pct_change enforcement	[14]	-0.113[a]	-0.115[a]	0.004	0.028[a]	0.010[b]	-0.051[a]	0.033[a]	0.035[a]	-0.097[a]	0.031[a]	-0.057[a]	-0.003	0.031[a]	1								
Pct_staff_audit	[15]	-0.005	-0.021[a]	-0.013[b]	-0.040[a]	0.104[a]	0.026[a]	0.169[a]	0.019[a]	0.043[a]	-0.002	0.029[a]	-0.016[a]	-0.040[a]	-0.018[a]	1							
Pct_staff_LTO	[16]	0.039[a]	0.018[a]	0.299[a]	0.355[a]	0.526[a]	0.438[a]	0.495[a]	0.041[a]	0.387[a]	-0.040[a]	-0.019[a]	0.215[a]	-0.019[a]	0.058[a]	0.028[a]	1						
Staff_tenure	[17]	0.161[a]	0.202[a]	-0.045[a]	-0.047[a]	-0.055[a]	0.086[a]	-0.092[a]	-0.164[a]	0.154[a]	-0.044[a]	0.197[a]	0.002	-0.064[a]	-0.120[a]	0.018[a]	-0.248[a]	1					
Staff_departing (percentage)	[18]	0.062[a]	0.056[a]	0.308[a]	0.384[a]	0.619[a]	0.544[a]	0.576[a]	0.024[a]	0.492[a]	-0.054[a]	0.006[c]	0.253[a]	-0.057[a]	-0.113[a]	-0.028[a]	0.616[a]	-0.338[a]	1				
AI_ML_categorical	[19]	-0.073[a]	-0.090[a]	0.006	0.005	0.406[a]	0.234[a]	0.437[a]	0.324[a]	0.210[a]	-0.101[a]	-0.004	0.144[a]	-0.041[a]	-0.100[a]	-0.030[a]	0.407[a]	-0.151[a]	0.333[a]	1			
AI & ML	[20]	-0.198[a]	-0.247[a]	0.069[a]	0.082[a]	0.387[a]	0.152[a]	0.437[a]	0.352[a]	0.106[a]	-0.076[a]	-0.076[a]	0.156[a]	-0.018[a]	-0.005	-0.089[a]	0.508[a]	-0.221[a]	0.372[a]	0.824[a]	1		
Robotics_categorical	[21]	-0.264[a]	-0.316[a]	0.141[a]	0.201[a]	0.017[a]	0.155[a]	-0.049[a]	-0.031[a]	0.078[a]	-0.027[a]	-0.152[a]	0.056[a]	-0.040[a]	0.101[a]	0.081[a]	0.561[a]	-0.246[a]	0.555[a]	0.163[a]	0.334[a]	1	
Robotics	[22]	-0.187[a]	-0.227[a]	0.100[a]	0.137[a]	-0.135[a]	0.082[a]	-0.187[a]	-0.209[a]	0.067[a]	-0.035[a]	-0.138[a]	-0.019[a]	-0.033[a]	0.061[a]	0.036[a]	0.370[a]	-0.116[a]	0.357[a]	0.065[a]	0.225[a]	0.907[a]	1

Notes: Significance levels: [a] p<0.01, [b] p<0.05, [c] p<0.1

Table 4
E-government and tax avoidance

The dependent variables are annual CASH ETR and CURRENT ETR. The variable of interest is the e-government development index (EGDI). The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CASH ETR	CASH ETR	CURRENT ETR	CURRENT ETR	CURRENT ETR	CASH ETR	CURRENT ETR	CASH ETR	CURRENT ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
EGDI	0.122***	0.211***	0.175***	0.057***	0.109***	0.091***	0.140***	0.063***	0.121***	0.047***
	[10.080]	[14.679]	[12.334]	[7.363]	[11.440]	[9.307]	[8.720]	[6.459]	[9.471]	[5.114]
Size	0.005	0.005	0.005	0.009***	0.010***	0.011***	0.024***	0.022***	-0.000	0.006***
	[1.227]	[1.228]	[1.342]	[4.112]	[4.535]	[4.700]	[4.345]	[7.279]	[-0.089]	[2.763]
Growth	-0.096***	-0.092***	-0.091***	-0.021***	-0.018***	-0.017***	-0.033***	-0.006*	-0.090***	-0.016***
	[-24.054]	[-23.682]	[-23.182]	[-9.003]	[-7.886]	[-7.078]	[-6.131]	[-1.918]	[-23.097]	[-6.887]
Profitability	-0.992***	-1.040***	-1.045***	-0.467***	-0.476***	-0.473***	-0.437***	-0.192***	-1.038***	-0.468***
	[-38.736]	[-41.184]	[-41.009]	[-28.862]	[-29.443]	[-28.396]	[-13.285]	[-9.880]	[-41.138]	[-28.546]
Leverage	-0.044**	-0.043**	-0.029*	-0.025**	-0.020*	-0.014	-0.054**	-0.018	-0.013	-0.000
	[-2.567]	[-2.538]	[-1.700]	[-2.380]	[-1.882]	[-1.283]	[-2.485]	[-1.469]	[-0.752]	[-0.020]
Age (log)	0.033***	-0.061***	-0.061***	0.019***	-0.000	0.001	-0.066***	0.017***	-0.069***	-0.005*
	[14.367]	[-12.481]	[-12.439]	[13.513]	[-0.021]	[0.344]	[-6.600]	[3.008]	[-14.039]	[-1.805]
Loss	0.392***	0.393***	0.389***	0.451***	0.452***	0.449***	0.270***	0.325***	0.389***	0.449***
	[34.025]	[34.070]	[33.319]	[39.136]	[39.086]	[39.246]	[6.162]	[7.332]	[33.219]	[39.286]
NOLREV	-0.082***	-0.050***	-0.049***	-0.042***	-0.033***	-0.034***	-0.079***	-0.032***	-0.048***	-0.033***
	[-9.840]	[-6.210]	[-6.212]	[-9.194]	[-7.368]	[-7.410]	[-7.751]	[-5.942]	[-6.101]	[-7.277]
Intangible	0.368***	0.250***	0.253***	0.112***	0.072***	0.074***	0.241***	0.071***	0.269***	0.087***
	[14.713]	[10.669]	[11.254]	[8.310]	[5.489]	[5.609]	[9.307]	[5.204]	[12.282]	[6.839]
R&D (rnd)	4.684***	3.694***	3.480***	1.322***	0.995***	0.974***	3.039***	0.824***	3.310***	0.833***
	[26.128]	[23.038]	[22.650]	[18.645]	[14.715]	[14.531]	[17.179]	[11.017]	[22.294]	[13.066]
Inventory	-0.005	-0.026	0.007	-0.010	-0.009	0.007	0.058*	0.022	0.012	0.012
	[-0.174]	[-0.911]	[0.261]	[-0.674]	[-0.642]	[0.510]	[1.785]	[1.448]	[0.469]	[0.843]
PPE	-0.160***	-0.122***	-0.094***	-0.103***	-0.086***	-0.072***	-0.075***	-0.064***	-0.083***	-0.062***
	[-7.948]	[-6.410]	[-5.117]	[-9.906]	[-8.485]	[-7.115]	[-3.346]	[-5.691]	[-4.551]	[-6.315]
BIG4	-0.007	-0.013**	-0.014**	0.005	0.002	0.000	-0.006	0.001	-0.014**	-0.000
	[-1.139]	[-2.124]	[-2.397]	[1.314]	[0.626]	[0.026]	[-0.971]	[0.132]	[-2.508]	[-0.078]
Volatility (log)	0.001	0.010***	0.013***	0.001	0.004***	0.005***	-0.003	-0.001	0.013***	0.005***
	[0.303]	[5.827]	[7.656]	[1.364]	[4.204]	[4.545]	[-1.196]	[-0.982]	[7.885]	[4.840]
Advertising	-1.558*	-2.155**	-1.791**	-0.851	-1.083*	-1.080*	-0.446	0.202	-1.993**	-1.248**
	[-1.801]	[-2.466]	[-2.073]	[-1.359]	[-1.769]	[-1.818]	[-0.480]	[0.281]	[-2.437]	[-2.237]
Capex	-0.147***	-0.136***	-0.127***	-0.062***	-0.060***	-0.058***	-0.123***	-0.034***	-0.122***	-0.053***
	[-9.346]	[-9.185]	[-8.788]	[-7.484]	[-7.413]	[-7.074]	[-6.874]	[-3.771]	[-8.488]	[-6.610]

(Table 4 continues on next page)

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ITAXSTAFF	-0.109***	-0.130***	-0.139***	-0.029***	-0.034***	-0.035***	-0.139***	-0.036***	-0.160***	-0.052***
	[-26.223]	[-29.347]	[-28.248]	[-11.327]	[-12.013]	[-11.472]	[-24.108]	[-10.783]	[-31.280]	[-16.793]
PI_growth (log)							-0.007***	0.000		
							[-8.676]	[0.044]		
STR									1.033***	0.856***
									[22.046]	[26.686]
Constant	1.482***	1.772***	1.860***	0.469***	0.492***	0.501***	1.769***	0.409***	1.899***	0.533***
	[27.299]	[30.032]	[29.348]	[13.998]	[13.212]	[12.605]	[22.796]	[9.053]	[30.061]	[13.592]
Observations	82,523	82,523	82,126	82,523	82,523	82,126	38,771	38,771	82,126	82,126
Adj. R-squared	0.437	0.474	0.503	0.504	0.516	0.528	0.577	0.597	0.508	0.537
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	-	Yes	-	-	Yes	-	-	-	-	-
Industry-Year FE	-	-	Yes	-	-	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Table 5
E-government and Tax Avoidance using EGDI subcomponents

The dependent variable is annual CASH ETR (column (1)-(4)) and CURRENT ETR (column (5)-(8)). The observational units are global firms. The lower part of the table shows different types of fixed effects used in each regression. The table reports coefficient estimates and t-statistics (in square brackets) with fixed effect using cluster robust standard error at firm. The *, **, and *** denote significance at 10%, 5%, and 1% significant level respectively. All variables are defined in Table 1.

	CASH ETR				CURRENT ETR			
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Online Service Index	0.219***				0.108***			
	[19.987]				[15.731]			
Telecommunications		0.199***				0.092***		
Infrastructure Index		[15.091]				[11.154]		
Human Capital Index			0.000***				0.000***	
			[5.062]				[4.503]	
E-Participation Index				0.164***				0.086***
				[20.467]				[16.955]
Size	0.000	0.004	0.009**	0.002	0.009***	0.011***	0.013***	0.009***
	[0.025]	[0.968]	[2.352]	[0.556]	[3.667]	[4.520]	[5.568]	[4.028]
Growth	-0.088***	-0.090***	-0.092***	-0.089***	-0.016***	-0.017***	-0.018***	-0.016***
	[-22.763]	[-23.180]	[-23.373]	[-22.857]	[-6.678]	[-7.059]	[-7.308]	[-6.788]
Profitability	-1.047***	-1.037***	-1.044***	-1.051***	-0.474***	-0.469***	-0.472***	-0.476***
	[-41.408]	[-40.815]	[-40.796]	[-41.461]	[-28.614]	[-28.205]	[-28.278]	[-28.714]
Leverage	-0.011	-0.031*	-0.040**	-0.013	-0.005	-0.015	-0.020*	-0.006
	[-0.647]	[-1.843]	[-2.335]	[-0.790]	[-0.482]	[-1.444]	[-1.822]	[-0.529]
Age (log)	-0.063***	-0.062***	-0.060***	-0.064***	0.000	0.001	0.002	-0.001
	[-12.883]	[-12.501]	[-12.110]	[-13.057]	[0.013]	[0.345]	[0.601]	[-0.184]
Loss	0.390***	0.389***	0.388***	0.389***	0.449***	0.449***	0.449***	0.449***
	[33.394]	[33.327]	[33.367]	[33.490]	[39.285]	[39.249]	[39.252]	[39.284]
NOLREV	-0.046***	-0.048***	-0.052***	-0.047***	-0.033***	-0.034***	-0.035***	-0.033***
	[-5.869]	[-6.085]	[-6.416]	[-5.914]	[-7.131]	[-7.327]	[-7.610]	[-7.156]
Intangible	0.259***	0.251***	0.248***	0.252***	0.076***	0.072***	0.071***	0.073***
	[11.712]	[11.203]	[10.896]	[11.373]	[5.890]	[5.506]	[5.347]	[5.636]
R&D (rnd)	3.333***	3.415***	3.562***	3.358***	0.904***	0.950***	1.016***	0.910***
	[22.258]	[22.411]	[22.887]	[22.305]	[13.737]	[14.192]	[15.026]	[13.819]
Inventory	0.014	0.014	-0.002	0.011	0.011	0.010	0.003	0.009
	[0.550]	[0.543]	[-0.061]	[0.412]	[0.764]	[0.716]	[0.202]	[0.661]
PPE	-0.083***	-0.088***	-0.105***	-0.084***	-0.066***	-0.070***	-0.077***	-0.066***
	[-4.544]	[-4.841]	[-5.682]	[-4.573]	[-6.644]	[-6.945]	[-7.617]	[-6.608]
BIG4	-0.014**	-0.013**	-0.013**	-0.015***	-0.000	0.000	0.000	-0.001
	[-2.510]	[-2.369]	[-2.263]	[-2.623]	[-0.059]	[0.072]	[0.130]	[-0.158]
Volatility (log)	0.013***	0.013***	0.013***	0.013***	0.005***	0.005***	0.005***	0.005***
	[7.615]	[7.678]	[7.753]	[7.725]	[4.503]	[4.562]	[4.644]	[4.601]
Advertising	-1.580*	-1.777**	-1.890**	-1.565*	-0.979*	-1.080*	-1.131*	-0.962*
	[-1.907]	[-2.052]	[-2.152]	[-1.859]	[-1.687]	[-1.812]	[-1.883]	[-1.651]
Capex	-0.124***	-0.127***	-0.127***	-0.124***	-0.056***	-0.058***	-0.058***	-0.056***
	[-8.654]	[-8.833]	[-8.709]	[-8.554]	[-6.936]	[-7.093]	[-7.009]	[-6.855]
ITAXSTAFF	-0.132***	-0.142***	-0.138***	-0.141***	-0.032***	-0.037***	-0.035***	-0.036***
	[-27.289]	[-28.674]	[-28.088]	[-28.836]	[-10.481]	[-11.922]	[-11.354]	[-11.903]
Constant	1.780***	1.923***	1.944***	1.909***	0.464***	0.536***	0.542***	0.527***
	[28.422]	[30.371]	[30.356]	[30.328]	[11.764]	[13.611]	[13.723]	[13.433]
Observations	82,126	82,126	82,126	82,126	82,126	82,126	82,126	82,126
Adj. R-squared	0.507	0.504	0.501	0.507	0.530	0.528	0.527	0.530
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Table 6
Instrumental Variables Estimations for Tax Avoidance – First Set of Instruments

The dependent variable is annual CASH ETR (columns (2), (5), (8)) and CURRENT ETR (columns (3), (6), and (9)). The variable of interest is the e-government development index (EGDI). E-government is instrumented by the percentage of urban population. The observational units are global firms. The table reports coefficient estimates and t-statistics (in square brackets). Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

Instrument	**$URBANPOP_t$**			**$URBANPOP_{t-5}$**			**$URBANPOP_{t-10}$**		
		CASH ETR	**CURRENT ETR**		**CASH ETR**	**CURRENT ETR**		**CASH ETR**	**CURRENT ETR**
VARIABLES	**First-stage**	**Second-stage**		**First-stage**	**Second-stage**		**First-stage**	**Second-stage**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
EGDI (fitted)		2.506***	1.002***		2.554***	1.031***		2.494***	1.019***
		[34.356]	[28.473]		[34.091]	[28.551]		[32.990]	[27.828]
Instrument	0.017***			0.015***			0.014***		
	[53.875]			[52.334]			[49.053]		
Size	0.004***	-0.046***	-0.009***	0.005***	-0.047***	-0.010***	0.006***	-0.046***	-0.009***
	[3.523]	[-8.720]	[-3.347]	[4.404]	[-8.830]	[-3.554]	[5.292]	[-8.669]	[-3.470]
Growth	-0.001	-0.074***	-0.011***	-0.001	-0.074***	-0.010***	-0.002*	-0.074***	-0.010***
	[-0.829]	[-16.106]	[-4.134]	[-1.308]	[-15.928]	[-4.034]	[-1.775]	[-16.143]	[-4.072]
Profitability	0.024***	-1.033***	-0.469***	0.025***	-1.033***	-0.468***	0.025***	-1.034***	-0.468***
	[3.336]	[-33.711]	[-26.300]	[3.418]	[-33.467]	[-26.167]	[3.496]	[-33.767]	[-26.218]
Leverage	-0.033***	0.113***	0.042***	-0.035***	0.116***	0.043***	-0.037***	0.112***	0.043***
	[-5.800]	[5.108]	[3.450]	[-6.113]	[5.189]	[3.572]	[-6.369]	[5.075]	[3.524]
Age (log)	0.005***	-0.082***	-0.007**	0.005***	-0.082***	-0.007**	0.005**	-0.082***	-0.007**
	[3.008]	[-12.001]	[-2.001]	[2.952]	[-11.949]	[-2.056]	[2.557]	[-12.022]	[-2.035]
Loss	0.001	0.396***	0.452***	0.001	0.396***	0.452***	0.001	0.396***	0.452***
	[0.344]	[25.809]	[37.225]	[0.286]	[25.616]	[37.116]	[0.188]	[25.856]	[37.160]
NOLREV	-0.002	-0.021**	-0.023***	-0.003	-0.021**	-0.023***	-0.003	-0.021**	-0.023***
	[-0.787]	[-2.071]	[-4.446]	[-0.958]	[-1.995]	[-4.343]	[-1.132]	[-2.089]	[-4.383]
Intangible	-0.045***	0.330***	0.104***	-0.045***	0.331***	0.104***	-0.045***	0.329***	0.104***
	[-7.238]	[12.736]	[7.476]	[-7.173]	[12.705]	[7.500]	[-7.198]	[12.734]	[7.486]
R&D (rnd)	-0.133***	2.300***	0.513***	-0.110***	2.275***	0.498***	-0.088***	2.306***	0.504***
	[-4.521]	[15.704]	[7.554]	[-3.741]	[15.492]	[7.302]	[-3.052]	[15.762]	[7.396]
Inventory	-0.009	0.131***	0.056***	-0.010	0.133***	0.057***	-0.012*	0.130***	0.056***
	[-1.311]	[4.266]	[3.650]	[-1.515]	[4.319]	[3.728]	[-1.712]	[4.251]	[3.697]
PPE	-0.032***	0.067***	-0.009	-0.034***	0.070***	-0.007	-0.034***	0.066***	-0.007
	[-6.849]	[3.200]	[-0.818]	[-7.114]	[3.336]	[-0.625]	[-7.159]	[3.165]	[-0.700]
BIG4	0.006**	-0.024***	-0.004	0.006**	-0.024***	-0.004	0.005**	-0.024***	-0.004
	[2.463]	[-2.952]	[-0.893]	[2.398]	[-2.947]	[-0.914]	[2.322]	[-2.952]	[-0.906]
Volatility (log)	-0.000	0.011***	0.004***	-0.000	0.011***	0.004***	0.000	0.011***	0.004***
	[-0.237]	[5.115]	[3.431]	[-0.130]	[5.056]	[3.387]	[0.118]	[5.131]	[3.404]
Advertising	-0.376***	-0.404	-0.539	-0.384***	-0.376	-0.521	-0.412***	-0.411	-0.528
	[-2.794]	[-0.482]	[-0.948]	[-2.836]	[-0.446]	[-0.917]	[-3.023]	[-0.490]	[-0.929]
Capex	0.014***	-0.131***	-0.059***	0.013***	-0.131***	-0.059***	0.013***	-0.131***	-0.059***
	[4.253]	[-8.139]	[-6.932]	[4.035]	[-8.103]	[-6.910]	[3.982]	[-8.148]	[-6.919]
ITAXSTAFF	0.001	-0.129***	-0.031***	0.000	-0.129***	-0.031***	-0.002	-0.129***	-0.031***
	[0.888]	[-24.082]	[-9.798]	[0.307]	[-23.938]	[-9.728]	[-1.525]	[-24.103]	[-9.751]
Observations		82,126	82,126		82,126	82,126		82,126	82,126
Cragg-Donald Wald F Stat		11,000	11,000		11,000	11,000		11,000	11,000
Kleibergen-Paap rk wald F Stat		2,903	2,903		2,739	2,739		2,406	2,406
Stock-Yogo critical values 10%		16.38	16.38		16.38	16.38		16.38	16.38
Firm FE		Yes	Yes		Yes	Yes		Yes	Yes
Industry-Year FE		Yes	Yes		Yes	Yes		Yes	Yes
Cluster		Firm	Firm		Firm	Firm		Firm	Firm

Table 7

Instrumental Variables Estimations for Tax Avoidance – Second Set of Instruments

The dependent variable is annual CASH ETR (column (2) and (5)) and CURRENT ETR (column (3) and (6)). The variable of interest is the e-government development index (EGDI). E-government is instrumented by mobile cellular subscriptions per 100 people in columns (1) to (3) and the percentage of individuals using the internet in columns (4) to (6). The observational units are global firms. The table reports coefficient estimates and t-statistics (in square brackets). Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

Instrument	**Mobile cellular subscriptions per 100 people**			**Percentage of individuals using the internet**		
		CASH ETR	**CURRENT ETR**		**CASH ETR**	**CURRENT ETR**
VARIABLES	**First-stage**	**Second stage**		**First-stage**	**Second stage**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EGDI (fitted)		2.350***	1.056***		1.459***	0.617***
		[26.172]	[21.292]		[17.797]	[12.959]
Instrument	0.002***			0.004***		
	[35.492]			[26.833]		
Size	0.014***	-0.043***	-0.010***	0.017***	-0.023***	-0.001
	[11.643]	[-7.992]	[-3.577]	[13.261]	[-4.932]	[-0.208]
Growth	-0.004***	-0.075***	-0.010***	-0.005***	-0.081***	-0.013***
	[-3.425]	[-16.641]	[-3.937]	[-4.145]	[-19.796]	[-5.410]
Profitability	0.008	-1.034***	-0.468***	0.004	-1.038***	-0.470***
	[1.054]	[-34.505]	[-26.059]	[0.541]	[-38.633]	[-27.755]
Leverage	-0.049***	0.103***	0.045***	-0.055***	0.049***	0.018
	[-8.073]	[4.769]	[3.647]	[-9.109]	[2.595]	[1.590]
Age (log)	0.009***	-0.080***	-0.007**	0.005***	-0.073***	-0.004
	[4.524]	[-12.147]	[-2.092]	[2.787]	[-12.921]	[-1.131]
Loss	-0.001	0.395***	0.452***	-0.003	0.393***	0.451***
	[-0.292]	[26.434]	[37.013]	[-0.849]	[30.060]	[38.454]
NOLREV	-0.009***	-0.023**	-0.023***	-0.008***	-0.034***	-0.028***
	[-3.156]	[-2.318]	[-4.245]	[-2.707]	[-3.948]	[-5.810]
Intangible	-0.039***	0.325***	0.105***	-0.035***	0.295***	0.091***
	[-5.731]	[12.767]	[7.485]	[-5.215]	[12.797]	[6.863]
R&D (rnd)	0.252***	2.379***	0.486***	0.334***	2.830***	0.708***
	[7.724]	[16.079]	[6.891]	[9.918]	[19.378]	[10.409]
Inventory	-0.031***	0.122***	0.058***	-0.048***	0.075***	0.035**
	[-4.304]	[4.052]	[3.762]	[-6.284]	[2.738]	[2.438]
PPE	-0.051***	0.056***	-0.005	-0.055***	-0.005	-0.035***
	[-10.420]	[2.697]	[-0.450]	[-10.970]	[-0.279]	[-3.407]
BIG4	0.007***	-0.023***	-0.004	0.003	-0.019***	-0.002
	[2.797]	[-2.961]	[-0.932]	[1.320]	[-2.948]	[-0.556]
Volatility (log)	0.000	0.011***	0.004***	0.001**	0.012***	0.004***
	[0.458]	[5.315]	[3.349]	[2.075]	[6.479]	[3.998]
Advertising	-0.698***	-0.497	-0.506	-0.561***	-1.027	-0.767
	[-3.606]	[-0.597]	[-0.888]	[-2.692]	[-1.265]	[-1.343]
Capex	0.006*	-0.131***	-0.059***	0.006*	-0.129***	-0.059***
	[1.773]	[-8.254]	[-6.890]	[1.663]	[-8.758]	[-7.134]
ITAXSTAFF	-0.014***	-0.130***	-0.031***	-0.003**	-0.134***	-0.033***
	[-11.939]	[-24.583]	[-9.694]	[-2.521]	[-26.779]	[-10.636]
Observations		82,126	82,126		82,126	82,126
Adj. R-squared		-0.271	-0.051		0.024	0.105
Cragg-Donald Wald F Statistics		4667	4667		4032	4032
Kleibergen-Paap rk wald F Stat		1260	1260		720	720
Stock-Yogo critical values 10%		16.38	16.38		16.38	16.38
Firm FE		Yes	Yes		Yes	Yes
Ind-Year FE		Yes	Yes		Yes	Yes
Cluster		Firm	Firm		Firm	Firm

Table 8
Mediating effect of AI and machine learning used by tax authorities on the association between e-government and tax avoidance

The dependent variable is annual CASH ETR and CURRENT ETR. The variable of interest is e-government (EGDI). The mediating variable is the adoption of AI and machine learning. It takes a value of 0 if the country has not yet implemented these technologies and 1 if they are in use. The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	AI & ML	**CASH ETR (without mediator)**	**CASH ETR (with mediator)**	**AI & ML**	**CURRENT ETR (without mediator)**	**CURRENT ETR (with mediator)**
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EGDI	-1.179***	0.179***	0.113***	-1.179***	0.092***	0.045***
	[-36.064]	[12.434]	[8.295]	[-36.064]	[9.364]	[4.594]
AI & ML			-0.056***			-0.040***
			[-13.793]			[-13.618]
Size	-0.047***	0.008*	0.005	-0.047***	0.012***	0.010***
	[-11.234]	[1.908]	[1.248]	[-11.234]	[4.925]	[4.137]
Growth	0.018***	-0.086***	-0.085***	0.018***	-0.016***	-0.015***
	[5.171]	[-21.876]	[-21.662]	[5.171]	[-6.576]	[-6.303]
Profitability	0.016	-1.056***	-1.055***	0.016	-0.476***	-0.475***
	[0.658]	[-41.063]	[-41.239]	[0.658]	[-28.552]	[-28.695]
Leverage	0.153***	-0.017	-0.009	0.153***	-0.011	-0.005
	[7.631]	[-1.006]	[-0.514]	[7.631]	[-1.012]	[-0.441]
Age (log)	-0.032***	-0.062***	-0.064***	-0.032***	0.001	-0.000
	[-5.013]	[-12.460]	[-12.837]	[-5.013]	[0.297]	[-0.137]
Loss	0.005	0.388***	0.389***	0.005	0.449***	0.449***
	[0.469]	[33.120]	[33.128]	[0.469]	[39.259]	[39.362]
NOLREV	0.025***	-0.043***	-0.042***	0.025***	-0.033***	-0.032***
	[2.840]	[-5.335]	[-5.198]	[2.840]	[-7.055]	[-6.900]
Intangible	0.062***	0.274***	0.278***	0.062***	0.079***	0.081***
	[2.595]	[11.977]	[12.251]	[2.595]	[5.993]	[6.259]
R&D (rnd)	-1.264***	3.640***	3.569***	-1.264***	1.015***	0.964***
	[-10.484]	[23.097]	[22.940]	[-10.484]	[15.023]	[14.491]
Inventory	0.096***	0.002	0.008	0.096***	0.006	0.010
	[4.226]	[0.078]	[0.279]	[4.226]	[0.421]	[0.701]
PPE	0.130***	-0.101***	-0.094***	0.130***	-0.073***	-0.068***
	[7.545]	[-5.346]	[-4.993]	[7.545]	[-7.235]	[-6.760]
BIG4	-0.033***	-0.016***	-0.018***	-0.033***	-0.000	-0.002
	[-4.163]	[-2.731]	[-3.063]	[-4.163]	[-0.109]	[-0.473]
Volatility (log)	-0.001	0.012***	0.012***	-0.001	0.004***	0.004***
	[-0.416]	[7.149]	[7.141]	[-0.416]	[4.355]	[4.346]
Advertising	-1.337	-1.740**	-1.815**	-1.337	-1.067*	-1.121*
	[-1.056]	[-2.030]	[-2.164]	[-1.056]	[-1.798]	[-1.937]
Capex	0.039***	-0.133***	-0.131***	0.039***	-0.059***	-0.058***
	[3.437]	[-9.011]	[-8.909]	[3.437]	[-7.228]	[-7.075]
Constant	1.262***	0.259***	0.329***	1.262***	0.096***	0.147***
	[35.046]	[8.476]	[10.683]	[35.046]	[5.312]	[8.005]
Observations	82,126	82,126	82,126	82,126	82,126	82,126
Adj. R-squared	0.638	0.494	0.496	0.638	0.526	0.529
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
Sobel test			12.88			12.74
Sobel test p-value			**0.000**			**0.000**
Indirect effect			**6.6%**			**4.7%**
Indirect/Total			**36.87%**			**51.1%**

Table 9

Mediating effect of robotics programming used by tax authorities on the association between e-government and tax avoidance

The dependent variable is annual CASH ETR and CURRENT ETR. The variable of interest is e-government (EGDI). The mediating variable measures robotics adoption, with a value of 0 indicating that the country has not yet implemented the technologies and a value of 1 indicating that they are in use. The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	Robotics	**CASH ETR (without mediator)**	**CASH ETR (with mediator)**	**Robotics**	**CURRENT ETR (without mediator)**	**CURRENT ETR (with mediator)**
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EGDI	-0.529***	0.179***	0.146***	-0.529***	0.092***	0.077***
	[-23.039]	[12.434]	[10.244]	[-23.039]	[9.364]	[7.847]
Robotics			-0.063***			-0.028***
			[-16.590]			[-11.747]
Size	-0.018***	0.008*	0.006	-0.018***	0.012***	0.011***
	[-3.811]	[1.908]	[1.642]	[-3.811]	[4.925]	[4.741]
Growth	-0.012***	-0.086***	-0.086***	-0.012***	-0.016***	-0.016***
	[-2.654]	[-21.876]	[-22.219]	[-2.654]	[-6.576]	[-6.755]
Profitability	0.240***	-1.056***	-1.041***	0.240***	-0.476***	-0.469***
	[7.554]	[-41.063]	[-40.752]	[7.554]	[-28.552]	[-28.218]
Leverage	-0.150***	-0.017	-0.027	-0.150***	-0.011	-0.015
	[-6.287]	[-1.006]	[-1.570]	[-6.287]	[-1.012]	[-1.413]
Age (log)	-0.021***	-0.062***	-0.063***	-0.021***	0.001	0.000
	[-2.756]	[-12.460]	[-12.789]	[-2.756]	[0.297]	[0.097]
Loss	-0.001	0.388***	0.388***	-0.001	0.449***	0.449***
	[-0.046]	[33.120]	[32.971]	[-0.046]	[39.259]	[39.265]
NOLREV	0.000	-0.043***	-0.043***	0.000	-0.033***	-0.033***
	[0.010]	[-5.335]	[-5.415]	[0.010]	[-7.055]	[-7.117]
Intangible	-0.106***	0.274***	0.267***	-0.106***	0.079***	0.076***
	[-4.001]	[11.977]	[11.854]	[-4.001]	[5.993]	[5.806]
R&D (rnd)	-2.108***	3.640***	3.507***	-2.108***	1.015***	0.955***
	[-14.867]	[23.097]	[22.659]	[-14.867]	[15.023]	[14.259]
Inventory	0.136***	0.002	0.011	0.136***	0.006	0.010
	[4.284]	[0.078]	[0.402]	[4.284]	[0.421]	[0.704]
PPE	0.136***	-0.101***	-0.092***	0.136***	-0.073***	-0.069***
	[5.844]	[-5.346]	[-4.974]	[5.844]	[-7.235]	[-6.918]
BIG4	0.007	-0.016***	-0.015***	0.007	-0.000	-0.000
	[0.656]	[-2.731]	[-2.706]	[0.656]	[-0.109]	[-0.052]
Volatility (log)	-0.002	0.012***	0.012***	-0.002	0.004***	0.004***
	[-1.051]	[7.149]	[7.120]	[-1.051]	[4.355]	[4.317]
Advertising	-2.173**	-1.740**	-1.877**	-2.173**	-1.067*	-1.129*
	[-2.433]	[-2.030]	[-2.196]	[-2.433]	[-1.798]	[-1.911]
Capex	0.026*	-0.133***	-0.132***	0.026*	-0.059***	-0.059***
	[1.648]	[-9.011]	[-9.020]	[1.648]	[-7.228]	[-7.199]
Constant	0.651***	0.259***	0.300***	0.651***	0.096***	0.115***
	[17.080]	[8.476]	[9.905]	[17.080]	[5.312]	[6.357]
Observations	82,126	82,126	82,126	82,126	82,126	82,126
Adj. R-squared	0.557	0.494	0.497	0.557	0.526	0.528
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
Sobel test			13.46			10.47
Sobel test p-value			**0.000**			**0.000**
Indirect effect			**3.3%**			**1.5%**
Indirect/Total			**18.44%**			**16.3%**

Table 10

Mediating effect of total tax enforcement budget on the association between e-government and tax avoidance

The dependent variable is annual CASH ETR and CURRENT ETR. The variable of interest is e-government (EGDI). The mediating variable is total budget of tax spending in log. The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	Total tax enforcement budget (log)	**CASH ETR (without mediator)**	**CASH ETR (with mediator)**	**Total tax enforcement budget (log)**	**CURRENT ETR (without mediator)**	**CURRENT ETR (with mediator)**
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EGDI	0.415***	0.179***	0.126***	0.415***	0.092***	0.067***
	[22.491]	[12.434]	[9.577]	[22.491]	[9.364]	[6.887]
Total tax enforcement budget (log)			-0.110***			-0.027***
			[-14.468]			[-6.442]
Size	-0.112***	0.008*	-0.021***	-0.112***	0.012***	0.004
	[-3.532]	[1.908]	[-4.679]	[-3.532]	[4.925]	[1.384]
Growth	-0.016**	-0.086***	-0.073***	-0.016**	-0.016***	-0.010***
	[-2.538]	[-21.876]	[-17.671]	[-2.538]	[-6.576]	[-3.726]
Profitability	-0.079**	-1.056***	-1.160***	-0.079**	-0.476***	-0.553***
	[-2.124]	[-41.063]	[-43.947]	[-2.124]	[-28.552]	[-30.158]
Leverage	0.034	-0.017	-0.026	0.034	-0.011	-0.017
	[0.859]	[-1.006]	[-1.597]	[0.859]	[-1.012]	[-1.458]
Age (log)	0.010	-0.062***	-0.052***	0.010	0.001	0.004
	[0.861]	[-12.460]	[-10.680]	[0.861]	[0.297]	[1.146]
Loss	0.003	0.388***	0.396***	0.003	0.449***	0.453***
	[0.285]	[33.120]	[32.783]	[0.285]	[39.259]	[38.696]
NOLREV	0.035**	-0.043***	-0.011	0.035**	-0.033***	-0.024***
	[2.365]	[-5.335]	[-1.480]	[2.365]	[-7.055]	[-4.931]
Intangible	-0.103**	0.274***	0.206***	-0.103**	0.079***	0.044***
	[-2.332]	[11.977]	[9.514]	[-2.332]	[5.993]	[3.113]
R&D (rnd)	-1.156***	3.640***	2.913***	-1.156***	1.015***	0.872***
	[-9.138]	[23.097]	[20.240]	[-9.138]	[15.023]	[12.158]
Inventory	-0.051*	0.002	0.045*	-0.051*	0.006	0.017
	[-1.866]	[0.078]	[1.790]	[-1.866]	[0.421]	[1.149]
PPE	-0.014	-0.101***	-0.105***	-0.014	-0.073***	-0.082***
	[-0.426]	[-5.346]	[-5.893]	[-0.426]	[-7.235]	[-7.414]
BIG4	0.031**	-0.016***	-0.010*	0.031**	-0.000	0.001
	[2.014]	[-2.731]	[-1.909]	[2.014]	[-0.109]	[0.285]
Volatility (log)	0.007**	0.012***	0.012***	0.007**	0.004***	0.005***
	[2.102]	[7.149]	[7.136]	[2.102]	[4.355]	[4.530]
Advertising	0.229	-1.740**	-1.148	0.229	-1.067*	-0.899
	[0.408]	[-2.030]	[-1.474]	[0.408]	[-1.798]	[-1.534]
Capex	0.072***	-0.133***	-0.096***	0.072***	-0.059***	-0.054***
	[3.500]	[-9.011]	[-6.261]	[3.500]	[-7.228]	[-5.974]
Constant	-13.288***	0.259***	-1.002***	-13.288***	0.096***	-0.180***
	[-62.103]	[8.476]	[-8.419]	[-62.103]	[5.312]	[-2.801]
Observations	72,035	82,126	72,035	72,035	82,126	72,035
Adj. R-squared	0.955	0.494	0.509	0.955	0.526	0.498
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm
Sobel test			12.168			6.193
Sobel test p-value			**0.000**			**0.000**
Indirect effect			**5.3%**			**2.5%**
Indirect/Total			**29.61%**			**27.17%**

Table 11

Combined mediating effect of tax enforcement features on the association between e-government and tax avoidance

The dependent variable is annual CASH ETR and CURRENT ETR. The variable of interest is e-government (EGDI). The mediating variables are artificial intelligence total budget of tax spending in log. The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CASH ETR	CASH ETR	CASH ETR	CURRENT ETR	CURRENT ETR	CURRENT ETR	CURRENT ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
EGDI	0.179***	0.113***	0.094***	0.074***	0.092***	0.045***	0.036***	0.025***
	[12.434]	[8.295]	[6.831]	[5.938]	[9.364]	[4.594]	[3.756]	[2.588]
AI & ML		-0.056***	-0.047***	-0.043***		-0.040***	-0.036***	-0.034***
		[-13.793]	[-11.459]	[-10.752]		[-13.618]	[-12.246]	[-11.037]
Robotics			-0.058***	-0.011***			-0.024***	-0.010***
			[-15.145]	[-3.353]			[-9.949]	[-4.216]
Total tax enforcement budget (log)				-0.115***				-0.030***
				[-14.216]				[-6.879]
Size	0.008*	0.005	0.004	-0.024***	0.012***	0.010***	0.009***	0.001
	[1.908]	[1.248]	[1.113]	[-5.334]	[4.925]	[4.137]	[4.052]	[0.465]
Growth	-0.086***	-0.085***	-0.086***	-0.073***	-0.016***	-0.015***	-0.015***	-0.010***
	[-21.876]	[-21.662]	[-22.012]	[-17.640]	[-6.576]	[-6.303]	[-6.483]	[-3.665]
Profitability	-1.056***	-1.055***	-1.041***	-1.157***	-0.476***	-0.475***	-0.469***	-0.551***
	[-41.063]	[-41.239]	[-40.918]	[-43.919]	[-28.552]	[-28.695]	[-28.384]	[-30.116]
Leverage	-0.017	-0.009	-0.019	-0.020	-0.011	-0.005	-0.009	-0.012
	[-1.006]	[-0.514]	[-1.112]	[-1.240]	[-1.012]	[-0.441]	[-0.840]	[-1.069]
Age (log)	-0.062***	-0.064***	-0.065***	-0.054***	0.001	-0.000	-0.001	0.002
	[-12.460]	[-12.837]	[-13.073]	[-10.988]	[0.297]	[-0.137]	[-0.266]	[0.753]
Loss	0.388***	0.389***	0.388***	0.396***	0.449***	0.449***	0.449***	0.453***
	[33.120]	[33.128]	[32.990]	[32.724]	[39.259]	[39.362]	[39.356]	[38.741]
NOLREV	-0.043***	-0.042***	-0.042***	-0.010	-0.033***	-0.032***	-0.032***	-0.023***
	[-5.335]	[-5.198]	[-5.293]	[-1.388]	[-7.055]	[-6.900]	[-6.967]	[-4.848]
Intangible	0.274***	0.278***	0.271***	0.210***	0.079***	0.081***	0.079***	0.047***
	[11.977]	[12.251]	[12.088]	[9.776]	[5.993]	[6.259]	[6.070]	[3.365]
R&D (rnd)	3.640***	3.569***	3.460***	2.847***	1.015***	0.964***	0.918***	0.817***
	[23.097]	[22.940]	[22.559]	[20.047]	[15.023]	[14.491]	[13.873]	[11.561]
Inventory	0.002	0.008	0.014	0.051**	0.006	0.010	0.013	0.022
	[0.078]	[0.279]	[0.544]	[2.021]	[0.421]	[0.701]	[0.916]	[1.462]
PPE	-0.101***	-0.094***	-0.087***	-0.097***	-0.073***	-0.068***	-0.065***	-0.075***
	[-5.346]	[-4.993]	[-4.709]	[-5.421]	[-7.235]	[-6.760]	[-6.534]	[-6.795]
BIG4	-0.016***	-0.018***	-0.017***	-0.011**	-0.000	-0.002	-0.001	-0.000
	[-2.731]	[-3.063]	[-2.993]	[-2.173]	[-0.109]	[-0.473]	[-0.388]	[-0.004]
Volatility (log)	0.012***	0.012***	0.012***	0.012***	0.004***	0.004***	0.004***	0.005***
	[7.149]	[7.141]	[7.114]	[7.135]	[4.355]	[4.346]	[4.314]	[4.547]
Advertising	-1.740**	-1.815**	-1.928**	-1.245	-1.067*	-1.121*	-1.169**	-0.980*
	[-2.030]	[-2.164]	[-2.293]	[-1.624]	[-1.798]	[-1.937]	[-2.020]	[-1.707]
Capex	-0.133***	-0.131***	-0.130***	-0.094***	-0.059***	-0.058***	-0.057***	-0.052***
	[-9.011]	[-8.909]	[-8.933]	[-6.176]	[-7.228]	[-7.075]	[-7.065]	[-5.851]
Constant	0.259***	0.329***	0.355***	-1.005***	0.096***	0.147***	0.158***	-0.179***
	[8.476]	[10.683]	[11.572]	[-8.023]	[5.312]	[8.005]	[8.605]	[-2.622]
Observations	82,126	82,126	82,126	72,035	82,126	82,126	82,126	72,035
Adjusted R-squared	0.494	0.496	0.498	0.510	0.526	0.529	0.530	0.501
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Table 12
E-government and tax avoidance moderated by organizational capital (using total assets)

The dependent variable is annual CASH ETR and CURRENT ETR (column (1) and (2)) and three-year long-run CASH ETR and CURRENT ETR (column (3) and (4)). The variable of interest is the e-government development index (EGDI). The interaction variable is Organizational Capital scaled by total assets (OC_TA). The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CURRENT ETR	CASHLR ETR	CURRENTLR ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**
EGDI	0.167***	0.089***	0.212***	0.107***
	[10.147]	[7.502]	[13.888]	[11.559]
Organizational Capital (OC_TA)	-0.063***	-0.030***	-0.052***	-0.023***
	[-8.728]	[-7.224]	[-7.775]	[-6.255]
EGDI x OC_TA	0.124***	0.058***	0.107***	0.046***
	[11.689]	[8.987]	[11.142]	[7.983]
Size	0.002	0.007**	0.022***	0.011***
	[0.375]	[2.272]	[4.673]	[4.325]
Growth	-0.086***	-0.014***	-0.035***	-0.004***
	[-20.401]	[-5.530]	[-11.178]	[-2.835]
Profitability	-1.008***	-0.465***	-0.383***	-0.096***
	[-35.518]	[-24.421]	[-18.029]	[-8.381]
Leverage	0.002	0.012	-0.018	-0.005
	[0.081]	[1.004]	[-1.046]	[-0.523]
Age (log)	-0.050***	0.008**	-0.052***	-0.003
	[-8.685]	[2.445]	[-9.788]	[-1.212]
Loss	0.389***	0.439***	0.106***	0.113***
	[27.080]	[29.876]	[10.182]	[12.683]
NOLREV	-0.056***	-0.040***	-0.088***	-0.042***
	[-5.983]	[-7.916]	[-9.958]	[-10.187]
Intangible	0.273***	0.083***	0.237***	0.070***
	[10.957]	[5.937]	[10.562]	[6.336]
R&D (rnd)	3.386***	0.947***	2.579***	0.494***
	[19.712]	[12.106]	[18.095]	[9.151]
Inventory	0.049	0.023	0.015	0.008
	[1.569]	[1.532]	[0.534]	[0.625]
PPE	-0.066***	-0.075***	-0.074***	-0.063***
	[-3.220]	[-6.703]	[-3.875]	[-7.135]
BIG4	-0.010	-0.003	-0.011*	-0.002
	[-1.552]	[-0.761]	[-1.807]	[-0.537]
Volatility (log)	0.014***	0.005***	0.001	0.000
	[7.090]	[4.647]	[0.534]	[0.148]
Advertising	-1.098	-0.193	-0.578	0.405
	[-1.127]	[-0.283]	[-0.677]	[0.658]
Capex	-0.099***	-0.043***	-0.091***	-0.016***
	[-6.583]	[-4.947]	[-6.978]	[-2.587]
ITAXSTAFF	-0.141***	-0.036***	-0.148***	-0.043***
	[-25.012]	[-10.687]	[-29.103]	[-16.012]
Constant	1.868***	0.524***	1.782***	0.564***
	[24.951]	[11.546]	[26.044]	[15.488]
Observations	65,901	65,901	65,901	65,901
Adj. R-squared	0.549	0.574	0.675	0.756
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm

Table A1
Sample derivation

Criteria	Firm-Year Observations		N firms
Compustat Global	381,607		
Compustat North America	130,961		
			512,568
less: duplicates	-36,791		
less: fiscal year <2008 and NA	-6,061		
less: observations in financial service sectors (SIC 6000-6999)	-36,338		
less: observations in utility sectors (SIC 4900-4999)	-15,609		
less: observations SIC NA	-962		
less: negative pre-tax income and NA	-129,960		
less: negative total income taxes and NA	-17,360		
less: negative income taxes paid and NA	-84,554		
less: negative current income taxes and NA	-20,575		
less: firms with <5 observations	-25,083		
less: firms without country income classification	-12		
less: firms without country itax enforcement information	-9797		
Unbalanced data		129,466	
dropped due to missing data		-46,943	
Final sample (balanced data)		82,523	10,936

Table A2

Number of firms by countries

Country name	Number of firms	Percentage (%)
China	3,688	33.72
India	1,693	15.48
United States	1,194	10.92
Malaysia	429.0	3.920
Thailand	404.0	3.690
United Kingdom	353.0	3.230
Singapore	290.0	2.650
Indonesia	250.0	2.290
Germany	246.0	2.250
Australia	222.0	2.030
Sweden	202.0	1.850
France	179.0	1.640
Poland	160.0	1.460
Israel	144.0	1.320
Turkey	121.0	1.110
Italy	113.0	1.030
South Africa	106.0	0.970
Rest of the jurisdictions	1,142	10.44
Total firms	10,936	100.0
Total firm-year observations	82,523	

Table A3
Number of Firms by industry

Panel A: Number of firms by industries		
Industry Name	**Number of Firms**	**Percentage (%)**
Manufacturing	6,652	60.83
Services	1,675	15.32
Transportation	624.0	5.710
Retail Trade	574.0	5.250
Wholesale Trade	511.0	4.670
Construction	409.0	3.740
Mining	300.0	2.740
Agriculture, Forestry, and Fishing	116.0	1.060
Public Administration	75.00	0.690
Total firms	10,936	100.0
Total firm-year observations	82,523	100.0

Panel B: Descriptive statistics by industry

	Obs.	Mean	SD	Min	p25	Median	p75	Max
Agriculture, Forestry, Fishing								
Pretax Income	805.0	55.95	115.4	0.013	7.040	19.14	52.67	1,761
Total assets	805.0	781.2	2,081	0.697	137.8	334.8	691.8	26,353
CASH ETR	805.0	0.252	0.236	0.000	0.073	0.220	0.342	1.000
CURRENT ETR	805.0	0.186	0.175	0.000	0.019	0.179	0.277	1.000
Construction								
Pretax Income	2,899	235.3	804.2	0.004	9.596	33.68	128.5	15,644
Total assets	2,899	6,114	22,423	0.865	178.1	661.5	2,783	370,330
CASH ETR	2,899	0.347	0.282	0.000	0.155	0.271	0.442	1.000
CURRENT ETR	2,899	0.243	0.188	0.000	0.136	0.219	0.320	1.000
Manufacturing								
Pretax Income	50,882	193.2	1,154	0.001	7.129	20.56	76.19	72,515
Total assets	50,882	2.245	10,659	0.223	96.03	294.5	1,003	375,319
CASH ETR	50,882	0.316	0.265	0.000	0.143	0.258	0.411	1.000
CURRENT ETR	50,882	0.201	0.162	0.000	0.106	0.189	0.276	1.000
Mining								
Pretax Income	2,090	980.9	8,664	0.004	20.87	98.52	396.3	212,772
Total assets	2,090	6,445	24,701	1.359	286.8	1,352	4,815	576,717
CASH ETR	2,090	0.360	0.314	0.000	0.133	0.266	0.502	1.000
CURRENT ETR	2,090	0.251	0.210	0.000	0.124	0.227	0.325	1.000
Public Administration								
Pretax Income	582.0	562.2	1,787	0.197	20.43	102.4	333.8	20,098
Total assets	582.0	12,949	61,690	14.99	385.5	2,028	6,447	717,242
CASH ETR	582.0	0.298	0.270	0.000	0.118	0.230	0.351	1.000
CURRENT ETR	582.0	0.255	0.225	0.000	0.114	0.216	0.319	1.000
Retail Trade								
Pretax Income	4,414	415.2	1,711	0.003	17.55	51.40	181.8	38,155
Total assets	4,414	4,316	16,777	0.961	229.8	690.3	2,208	420,549
CASH ETR	4,414	0.333	0.264	0.000	0.176	0.266	0.387	1.000
CURRENT ETR	4,414	0.256	0.166	0.000	0.178	0.250	0.326	1.000
Services								
Pretax Income	12,015	212.1	1,584	0.000	6.627	19.34	72.56	71,102
Total assets	12,015	2,209	11,240	0.002	73.99	248.4	922.5	333,779
CASH ETR	12,015	0.295	0.229	0.000	0.149	0.256	0.379	1.000
CURRENT ETR	12,015	0.231	0.180	0.000	0.117	0.217	0.310	1.000
Transportation								
Pretax Income	4,694	436.5	1,638	0.008	13.92	58.43	238.8	29,420
Total assets	4,694	5,856	21,043	1.533	224.3	946.7	3,579	403,821
CASH ETR	4,694	0.280	0.235	0.000	0.130	0.238	0.360	1.000
CURRENT ETR	4,694	0.217	0.174	0.000	0.108	0.211	0.289	1.000
Wholesale Trade								
Pretax Income	3,745	122.1	304.6	0.000	4.550	19.06	91.93	6,891
Total assets	3,745	1,954	5,096	0.252	78.52	326.8	1,393	93,419
CASH ETR	3,745	0.301	0.241	0.000	0.155	0.254	0.368	1.000
CURRENT ETR	3,745	0.249	0.176	0.000	0.162	0.242	0.317	1.000

Table A4
E-government and long-run tax avoidance

The dependent variable is three-year long-run CASH ETR and CURRENT ETR (column (1)-(3)) and three-year long-run CASH ETR and CURRENT ETR (column (4)-(6)). The variable of interest is the e-government development index (EGDI). The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASHLR ETR	CASHLR ETR	CASHLR ETR	CURRENTLR ETR	CURRENTLR ETR	CURRENTLR ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EGDI	0.242***	0.280***	0.232***	0.094***	0.126***	0.104***
	[20.380]	[20.073]	[17.398]	[14.318]	[15.004]	[12.549]
Size	0.023***	0.017***	0.017***	0.011***	0.010***	0.011***
	[6.361]	[4.738]	[4.480]	[5.736]	[5.535]	[5.529]
Growth	-0.046***	-0.043***	-0.043***	-0.007***	-0.008***	-0.008***
	[-14.346]	[-13.851]	[-13.813]	[-4.624]	[-4.757]	[-4.651]
Profitability	-0.399***	-0.464***	-0.463***	-0.124***	-0.142***	-0.141***
	[-19.934]	[-23.561]	[-23.525]	[-11.348]	[-13.140]	[-12.726]
Leverage	-0.044***	-0.052***	-0.035**	-0.032***	-0.028***	-0.022**
	[-2.810]	[-3.311]	[-2.221]	[-3.621]	[-3.128]	[-2.434]
Age (log)	0.032***	-0.065***	-0.064***	0.029***	-0.007***	-0.006**
	[14.898]	[-14.057]	[-13.864]	[22.378]	[-2.713]	[-2.389]
Loss	0.121***	0.119***	0.117***	0.146***	0.146***	0.144***
	[13.481]	[13.144]	[12.740]	[17.307]	[17.283]	[17.299]
NOLREV	-0.126***	-0.095***	-0.094***	-0.058***	-0.047***	-0.047***
	[-15.771]	[-12.389]	[-12.415]	[-14.281]	[-11.920]	[-11.670]
Intangible	0.315***	0.225***	0.227***	0.094***	0.061***	0.059***
	[14.280]	[10.515]	[11.116]	[8.569]	[5.588]	[5.343]
R&D (rnd)	3.861***	3.162***	2.954***	0.902***	0.663***	0.629***
	[25.382]	[22.271]	[21.757]	[15.779]	[11.855]	[11.231]
Inventory	-0.046	-0.054**	-0.030	-0.002	-0.006	-0.000
	[-1.619]	[-2.010]	[-1.179]	[-0.141]	[-0.511]	[-0.023]
PPE	-0.164***	-0.133***	-0.106***	-0.098***	-0.082***	-0.070***
	[-8.690]	[-7.313]	[-6.056]	[-11.316]	[-9.758]	[-8.264]
BIG4	-0.004	-0.009*	-0.011**	0.006*	0.003	0.002
	[-0.721]	[-1.745]	[-2.218]	[1.889]	[1.062]	[0.487]
Volatility (log)	-0.010***	-0.000	0.003	-0.003***	-0.000	0.000
	[-6.524]	[-0.280]	[1.604]	[-3.733]	[-0.427]	[0.062]
Advertising	-0.716	-1.212	-1.164	-0.211	-0.414	-0.455
	[-0.913]	[-1.522]	[-1.550]	[-0.357]	[-0.702]	[-0.801]
Capex	-0.146***	-0.131***	-0.124***	-0.035***	-0.035***	-0.031***
	[-10.119]	[-9.522]	[-9.387]	[-5.342]	[-5.384]	[-4.875]
ITAXSTAFF	-0.147***	-0.142***	-0.148***	-0.047***	-0.040***	-0.041***
	[-35.398]	[-34.612]	[-32.664]	[-20.570]	[-16.771]	[-16.258]
Constant	1.707***	1.773***	1.851***	0.595***	0.539***	0.559***
	[32.705]	[32.455]	[31.552]	[20.976]	[17.343]	[17.101]
Observations	82,523	82,523	82,126	82,523	82,523	82,126
Adj R-squared	0.543	0.570	0.602	0.653	0.663	0.676
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	-	Yes	-	-	Yes	-
Ind-Year FE	-	-	Yes	-	-	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm

Table A5
E-government and tax avoidance including country controls

The dependent variable is annual GAAP ETR, CASH ETR, and CURRENT ETR (column (1)-(3)) and three-year long-run GAAP ETR, CASH ETR, and CURRENT ETR (column (4)-(6)). The variable of interest is the e-government development index (EGDI). The observational units are global firms. Firm controls are the same as in the baseline models. The table reports coefficient estimates and t-statistics (in square brackets). Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CASH ETR	CURRENT ETR	CURRENT ETR	CASHLR ETR	CASHLR ETR	CURRENTLR ETR	CURRENTLR ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
EGDI	0.385***	0.548***	0.156***	0.196***	0.204***	0.324***	0.112***	0.161***
	[6.208]	[8.943]	[4.165]	[4.936]	[4.549]	[6.459]	[4.014]	[5.043]
Size	-0.009	-0.012***	-0.007	-0.006***	0.004	-0.006***	-0.002	-0.004***
	[-1.404]	[-6.079]	[-1.540]	[-4.386]	[0.935]	[-3.377]	[-0.926]	[-3.118]
Growth	-0.073***	-0.093***	-0.013***	-0.019***	-0.023***	-0.047***	0.001	-0.006**
	[-12.533]	[-17.381]	[-3.805]	[-5.424]	[-5.875]	[-10.976]	[0.303]	[-2.332]
Profitability	-0.852***	-0.438***	-0.401***	-0.211***	-0.249***	-0.133***	-0.033**	-0.015
	[-23.356]	[-18.526]	[-15.851]	[-12.916]	[-11.257]	[-6.547]	[-2.303]	[-1.143]
Leverage	-0.001	-0.070***	-0.008	-0.056***	0.008	-0.048***	-0.008	-0.044***
	[-0.048]	[-4.648]	[-0.493]	[-4.576]	[0.474]	[-3.495]	[-0.748]	[-4.147]
Age (log)	-0.086***	-0.034***	-0.019***	0.009***	-0.051***	-0.051***	-0.017***	-0.000
	[-9.254]	[-9.185]	[-3.466]	[3.843]	[-7.900]	[-13.745]	[-4.621]	[-0.080]
Loss	0.404***	0.449***	0.394***	0.451***	0.117***	0.204***	0.105***	0.195***
	[20.870]	[24.952]	[19.966]	[23.171]	[8.357]	[12.666]	[8.667]	[12.311]
NOLREV	-0.058***	0.019***	-0.039***	-0.001	-0.084***	-0.007	-0.037***	-0.013***
	[-4.480]	[2.895]	[-5.319]	[-0.106]	[-8.801]	[-1.190]	[-6.519]	[-3.153]
Intangible	0.374***	0.129***	0.143***	0.057***	0.203***	0.123***	0.067***	0.058***
	[11.023]	[9.372]	[7.777]	[5.223]	[8.182]	[9.570]	[5.129]	[5.723]
R&D (rnd)	4.617***	1.201***	1.452***	0.216***	2.309***	0.943***	0.484***	0.076
	[16.444]	[14.617]	[12.059]	[3.793]	[14.048]	[12.222]	[7.106]	[1.445]
Inventory	0.099***	0.079***	0.046**	0.050***	0.017	0.087***	0.026**	0.050***
	[2.656]	[5.175]	[2.294]	[4.758]	[0.629]	[6.063]	[1.963]	[5.527]
PPE	-0.121***	0.022**	-0.075***	-0.023***	-0.120***	0.030***	-0.058***	-0.022***
	[-4.788]	[2.061]	[-5.270]	[-2.954]	[-6.260]	[2.853]	[-5.904]	[-3.220]
BIG4	0.008	0.012**	0.024***	0.025***	-0.010	0.019***	0.006	0.027***
	[0.723]	[2.408]	[3.082]	[6.427]	[-1.376]	[3.845]	[1.078]	[7.728]
Volatility (log)	0.006**	0.010***	0.003*	0.005***	-0.003*	0.004***	-0.002*	0.002*
	[2.483]	[5.926]	[1.739]	[4.259]	[-1.880]	[2.610]	[-1.891]	[1.935]
Advertising	-3.095**	-0.441	-2.562***	0.069	-1.148	-0.239	-1.003	0.147
	[-2.424]	[-1.581]	[-3.943]	[0.305]	[-1.157]	[-0.941]	[-1.564]	[0.699]
Capex	-0.060***	-0.103***	-0.038***	-0.043***	-0.037***	-0.112***	-0.009	-0.030***
	[-3.345]	[-7.032]	[-3.641]	[-4.442]	[-2.984]	[-8.849]	[-1.354]	[-3.764]
ITAXSTAFF	-0.277***	-0.351***	-0.092***	-0.097***	-0.164***	-0.235***	-0.042***	-0.042***
	[-20.552]	[-27.115]	[-11.335]	[-11.988]	[-17.132]	[-23.498]	[-7.274]	[-6.532]
Corruption	-0.034***	-0.043***	-0.020***	-0.021***	-0.031***	-0.039***	-0.015***	-0.020***
	[-5.691]	[-7.041]	[-4.513]	[-4.601]	[-7.650]	[-8.327]	[-5.239]	[-5.774]
Burreaucracy	0.223	0.406***	0.035	0.083	0.202**	0.352***	0.138***	0.106
	[1.609]	[3.390]	[0.555]	[0.926]	[2.267]	[3.559]	[2.627]	[1.325]
GDPPC	0.246***	0.372***	0.075***	0.113***	0.166***	0.277***	0.004	0.030***
	[23.841]	[37.362]	[11.818]	[17.530]	[21.072]	[32.516]	[0.924]	[5.271]
Constant	2.230***	2.066***	1.008***	0.741***	1.173***	1.198***	0.280*	0.238
	[5.226]	[5.622]	[4.938]	[2.728]	[4.253]	[3.983]	[1.693]	[0.991]
Observations	37,612	38,866	37,612	38,866	37,612	38,866	37,612	38,866
Adj R-squared	0.529	0.337	0.632	0.441	0.694	0.326	0.823	0.534
Firm FE	Yes	-	Yes	-	Yes	-	Yes	-
Ind-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	-	Yes	-	Yes	-	Yes	-	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Table A6
E-government and tax avoidance (current and lag)

The dependent variable is annual CASH ETR and CURRENT ETR (column (1) and (2)) and three-year long-run CASH ETR and CURRENT ETR (column (3) and (4)). The variable of interest is the current e-government development index (EGDI) (panel A), one-year lag of EGDI (L. EGDI) (panel B), and two-year lag of EGDI (L2. EGDI) (Panel C). The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

Panel A: EGDI (Current)

	CASH ETR	**CURRENT ETR**	**CASHLR ETR**	**CURRENTLR ETR**
	(1)	**(2)**	**(3)**	**(4)**
EGDI	0.175***	0.091***	0.232***	0.104***
	[12.334]	[9.307]	[17.398]	[12.549]
CONTROL	Yes	Yes	Yes	Yes
Observations	82,126	82,126	82,126	82,126
Adj R-squared	0.503	0.528	0.602	0.676
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm

Panel B: L. EGDI (One-year lag EGDI)

	CASH ETR	**CURRENT ETR**	**CASHLR ETR**	**CURRENTLR ETR**
	(1)	**(2)**	**(3)**	**(4)**
L. EGDI	0.185***	0.113***	0.253***	0.138***
	[11.183]	[10.179]	[15.728]	[13.490]
CONTROL	Yes	Yes	Yes	Yes
Observations	82,126	82,126	82,126	82,126
Adj R-squared	0.502	0.528	0.601	0.676
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm

Panel C: L2. EGDI (two-year lag EGDI)

	CASH ETR	**CURRENT ETR**	**CASHLR ETR**	**CURRENTLR ETR**
	(1)	**(2)**	**(3)**	**(4)**
L2. EGDI	0.396***	0.293***	0.566***	0.352***
	[10.532]	[12.047]	[16.486]	[18.244]
CONTROL	Yes	Yes	Yes	Yes
Observations	66,344	66,344	66,344	66,344
Adj R-squared	0.532	0.542	0.643	0.721
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm

Table A7
E-government and tax avoidance moderated by organizational capital (robustness using PPE)

The dependent variable is annual CASH ETR and CURRENT ETR (column (1) and (2)) and three-year long-run CASH ETR and CURRENT ETR (column (3) and (4)). The variable of interest is the e-government development index (EGDI). The interaction variable is Organizational Capital scaled by Property, Plant, and Equipment (OC_PPE). The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CURRENT ETR	CASHLR ETR	CURRENTLR ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**
EGDI	0.150***	0.079***	0.202***	0.098***
	[8.755]	[6.297]	[12.913]	[10.264]
Organizational Capital (OC_PPE)	-0.002**	-0.001	-0.002**	-0.001***
	[-2.083]	[-1.566]	[-2.361]	[-2.700]
EGDI x OC_PPE	0.003**	0.001*	0.002**	0.002**
	[2.148]	[1.685]	[2.253]	[2.531]
Size	0.005	0.009***	0.024***	0.013***
	[0.982]	[2.759]	[4.951]	[5.113]
Growth	-0.092***	-0.018***	-0.042***	-0.008***
	[-21.442]	[-6.744]	[-12.907]	[-4.622]
Profitability	-1.006***	-0.473***	-0.362***	-0.088***
	[-33.795]	[-23.701]	[-16.521]	[-7.481]
Leverage	-0.026	0.000	-0.041**	-0.014
	[-1.291]	[0.029]	[-2.320]	[-1.430]
Age (log)	-0.057***	0.001	-0.061***	-0.010***
	[-9.660]	[0.384]	[-11.217]	[-3.325]
Loss	0.389***	0.440***	0.105***	0.113***
	[26.852]	[30.302]	[9.977]	[12.494]
NOLREV	-0.068***	-0.045***	-0.101***	-0.048***
	[-7.088]	[-8.499]	[-11.164]	[-11.620]
Intangible	0.262***	0.079***	0.229***	0.064***
	[10.176]	[5.418]	[9.909]	[5.587]
R&D (rnd)	3.548***	1.018***	2.666***	0.536***
	[19.278]	[12.002]	[17.506]	[9.228]
Inventory	0.060*	0.033**	0.029	0.013
	[1.884]	[2.049]	[0.974]	[0.971]
PPE	-0.072***	-0.079***	-0.079***	-0.066***
	[-3.367]	[-6.811]	[-4.025]	[-7.342]
BIG4	-0.008	-0.007	-0.009	-0.002
	[-1.157]	[-1.509]	[-1.435]	[-0.582]
Volatility (log)	0.013***	0.006***	0.000	0.000
	[6.479]	[4.602]	[0.184]	[0.092]
Advertising	-1.069	-0.176	-0.626	0.379
	[-1.051]	[-0.249]	[-0.687]	[0.592]
Capex	-0.104***	-0.048***	-0.095***	-0.018***
	[-6.660]	[-5.240]	[-7.040]	[-2.830]
ITAXSTAFF	-0.139***	-0.035***	-0.148***	-0.043***
	[-23.977]	[-10.200]	[-28.256]	[-15.776]
Constant	1.844***	0.517***	1.785***	0.565***
	[23.901]	[11.097]	[25.287]	[15.141]
Observations	63,333	63,333	63,333	63,333
Adj R-squared	0.544	0.567	0.669	0.751
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm

Table A8

E-government and tax avoidance moderated by intangible assets

The dependent variable is annual CASH ETR and CURRENT ETR (column (1) and (2)) and three-year long-run CASH ETR and CURRENT ETR (column (3) and (4)). The variable of interest is the e-government development index (EGDI). The interaction variable is dummy variable of intangible assets. It takes value 1 if firm has intangible assets and 0 otherwise. The observational units are global firms. The table reports coefficient estimates and t-statistics in square brackets. Standard errors are adjusted for clustering at the firm level. Stars, ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively. All variables are defined in Table 1.

	CASH ETR	CURRENT ETR	CASHLR ETR	CURRENTLR ETR
VARIABLES	**(1)**	**(2)**	**(3)**	**(4)**
EGDI	0.032	0.024	0.049*	0.033**
	[1.107]	[1.264]	[1.952]	[2.109]
Intangible Assets	-0.067***	-0.033***	-0.096***	-0.033***
	[-3.898]	[-3.094]	[-6.321]	[-3.829]
EGDI x Intangible Assets	0.153***	0.073***	0.198***	0.078***
	[5.355]	[4.049]	[7.907]	[5.229]
Size	0.010**	0.012***	0.020***	0.012***
	[2.509]	[5.195]	[5.638]	[5.955]
Growth	-0.086***	-0.016***	-0.039***	-0.007***
	[-22.087]	[-6.609]	[-12.574]	[-4.097]
Profitability	-1.074***	-0.480***	-0.488***	-0.146***
	[-42.054]	[-28.820]	[-24.796]	[-13.146]
Leverage	-0.001	-0.006	-0.011	-0.016*
	[-0.036]	[-0.566]	[-0.707]	[-1.773]
Age (log)	-0.066***	-0.000	-0.068***	-0.007***
	[-13.362]	[-0.112]	[-14.724]	[-2.828]
Loss	0.388***	0.449***	0.117***	0.143***
	[33.218]	[39.189]	[12.657]	[17.275]
NOLREV	-0.049***	-0.034***	-0.093***	-0.047***
	[-6.143]	[-7.365]	[-12.339]	[-11.649]
R&D (rnd)	3.533***	0.986***	2.994***	0.637***
	[22.842]	[14.680]	[21.943]	[11.397]
Inventory	-0.021	-0.001	-0.054**	-0.006
	[-0.803]	[-0.052]	[-2.185]	[-0.557]
PPE	-0.131***	-0.082***	-0.139***	-0.078***
	[-7.192]	[-8.205]	[-8.041]	[-9.397]
BIG4	-0.014**	0.000	-0.012**	0.001
	[-2.365]	[0.013]	[-2.207]	[0.454]
Volatility (log)	0.014***	0.005***	0.003**	0.000
	[8.147]	[4.791]	[2.096]	[0.291]
Advertising	-1.750**	-1.074*	-1.136	-0.455
	[-2.129]	[-1.839]	[-1.601]	[-0.812]
Capex	-0.128***	-0.058***	-0.125***	-0.031***
	[-8.790]	[-7.051]	[-9.331]	[-4.846]
ITAXSTAFF	-0.142***	-0.036***	-0.151***	-0.042***
	[-28.792]	[-11.770]	[-33.149]	[-16.533]
Constant	1.966***	0.544***	1.976***	0.601***
	[29.759]	[13.366]	[32.174]	[17.783]
Observations	82,126	82,126	82,126	82,126
Adj R-squared	0.501	0.528	0.600	0.676
Firm FE	Yes	Yes	Yes	Yes
Ind-Year FE	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm